The Industrial Revolution and Music

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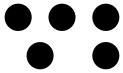

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Contents

1 Introduction

In this first session, I want to set the scene for this series of lectures and to produce a general background against which we can discuss the effect of the Industrial Revolution on our instruments, on the way in which, and the reasons why, music was performed, the genesis of our modern orchestra and its instruments, and all the conditions under which music has been performed for, roughly, the last two or three centuries.

I am using the term 'Industrial Revolution' in its widest sense – not necessarily from the first use of industrial machinery at Coalbrookdale, for example (the Industrial Revolution did start in England), or whatever other landmark of the beginnings of our modern age that a variety of people have used.

What I have in mind is the change from a mainly rural, mainly feudal economy to an urban, partly industrial, economy, with two important, for us, concomitant changes: a rise in the level of technology and the rise of an urban middle class.

Social economists and historians will almost certainly cavil at this over-simple definition, but where I want to start in musical, and organological, history, from next week onwards, is with the development of adequate technology to produce, for example, accurately made thin metal tubing, which permits the use of tuning slides, the introduction of the slow-feed on lathes, which permits the mass-production of gut strings covered with metal wire, and all the similar developments which affected other instruments.

The other factor which is important to us, and where we start today, is the arrival of a middle class which, wishing to acquire the graces and pleasures of the aristocracy, created the need for the public concert hall.

None of this happened simultaneously, and the various aspects of it didn't happen at the same time throughout Europe.

In England, for example, public concerts came rather earlier than in other parts of Europe. We did not have here the system of petty states, each with its own Archduke or Herzog and his court establishment, which was common in that area which, in the 19th century, became Germany. It is worth remembering that Germany was a creation of the late nineteenth century. Before that it was a hodge-podge of small states and free cities, all of which were separate from their neighbours, and all of which were hedged about by privileges and restrictions.

The feudal system broke up rather earlier in England than elsewhere. As a result we have had a very active entrepreneurial middle class from the middle of the seventeenth century onwards or even earlier. Perhaps this was due, to some extent at least, to the Commonwealth, that period after the Civil War when there was no king, no court, and, except for those who had prudently retired to their estates and maintained a very low profile, not much aristocracy. As a result, when the monarchy was restored, there was little native tradition extant in Britain of the minor court with its resident Kappellmeister, its court orchestra, and its private concerts. I'm not saying that it did not happen; Handel at Canons

is proof that it did. But it was not the mainstream of musical life here, as it was over much of the Continent. And certainly John Bannister is said to have been the first man in Europe, in 1673, to mount public concerts for an audience who paid to come in and hear the music. Equally, it is said that it was in London that the first public concert hall was built, in 1678, and our own Holywell Music Room, built 70 years later, is the world's oldest surviving concert hall still in use for that purpose.

Why did all this not happen also in the cities of the rest of Europe? There are a number of reasons. One is that our Civil War, traumatic as it was, lasted for only half a dozen years, whereas the Thirty Years War pillaged much of Central Europe for 30 years. Another is that public theatre was established here in the sixteenth century, with Shakespeare and his predecessors and successors, whereas in France, for example, the Théâtre of Racine, Corneille and Molière is a century later. As a result, English audiences were accustomed to going to public centres and paying for an entertainment, whereas our Continental contemporaries were not. Another was that much Continental music-making consisted of the small *Collegia* of interested amateurs, in Germany, and the *Accademia* of learned savants, in Italy, to take just two examples. These played for their own and each other's amusement, but they were open only to their own members and their guests, and not to the general public. The other branch of Continental music-making was the court orchestras, where the audience was the Prince, his family, and his invited guests.

In addition, what may well have been a valid substitute for what we think of, in Britain, as public concerts, was perhaps, over much of the rest of Europe, the Church. Here, of course, was music performed very much in public, whether it was Monteverdi and the Gabrielis in Venice, Schütz in Dresden, Bach in Cöthen and Leipzig, Charpentier in Paris, or anyone else. We did not have much church music of this type in Britain, with large instrumental resources, again partly due to the Puritan influence of the Commonwealth. But it could well be that if you heard JSB and his boys producing a new Cantata every Sunday, you didn't really feel the need for public orchestral concerts as well.

Where there were court orchestras and church orchestras, there was a living for professional musicians; they may have been treated and regarded by the courts, and by the Prince Bishops, as servants, but they could write and play more or less as much as they wished, and they were paid for it. In England, due to the lack of court and church orchestras, professional musicians were compelled to lay on their own public concerts if they wished to eat. Hence the musician John Banister providing his public concerts in 1673, and hence an early version of the Musicians' Union building, the York Buildings, in 1678.

Public orchestral concerts did not really get going over the rest of Europe until the last quarter of the eighteenth century. In 1781 the Leipzig Gewandhaus was built, and over the next 50 or 60 years most major European cities acquired a hall of similar size and importance, built specifically for public concerts.

The one form of music-making for a paying public which has an earlier history is that of the opera. Perhaps even in the Baroque period the opera was so expensive a musical form that it was beyond the reach of most princely purses, and only by allowing the public to come and pay to attend performances was it possible to put operas on the stage. Even today, the Royal Opera House gets a greater public subsidy than all the other London orchestras put together. Certainly there is evidence for public performances of opera, or equivalent forms such as the *Singspiel*, in Europe earlier in the eighteenth century than there is for the establishment of concert halls such as the Gewandhaus. The precedence of the opera does not stop there; as we shall see as we go along, many of our orchestral instruments first appeared either in the opera orchestra or in the military band.

We should not neglect the military band as an element in this history of public performance. In Britain the bands themselves were the personal property of the Colonel of the Regiment or of the Officers jointly. Nevertheless, its performances were inevitably public. If a regiment marches down the street with drums beating and band playing, everyone can hear it. Because the street acoustic is, let us say, unfavourable for musical performance, louder instruments were more popular for such ensembles. Perhaps this is true to some extent of the opera also, though effect and novelty were always an important influence there. If the audience is to have an unobstructed view of the stage in the opera house, it is desirable for the musicians to be behind it, under

it, curtained off from it, or more or less anywhere except where they can best be heard, leading to the necessity for increased orchestral volume, if only, as Sir Thomas Beecham would say, to drown the singers.

One of the prime effects of these new public concerts, as well as the conditions in the opera pit, on the history of instruments was the need to make more noise, to become more audible. One function of Court music was that of conspicuous consumption, to show that the Prince was wealthy enough to keep a court band, all dressed in his livery. But the prime function of music in many princely salons was much that of the Palm Court or of muzak in our restaurants today. It was a welcome background noise to cover the conversation and the gossip and it had the virtue of allowing people to gossip slanderously about their neighbours without being overheard by them. There were, of course, many exceptions. There were many courts where the Prince was an ardent lover of music, even a player in his own orchestra or a composer for it, but that did not mean that all his court, or all his invited friends and hangers-on, shared his love for music. Thus even in Frederick the Great's Berlin, even in Mannheim, even in Esterházy, not everyone listened to Carl Philip Emanuel, to Stamitz, or to Haydn, as we do in the Festival Hall or in the Sheldonian today.

With the rise of a moneyed bourgeoisie, things changed. If they wanted to hear music, it could only be possible in a public concert hall: few members of the rising middle class were wealthy

enough to maintain their own orchestras and to ape the aristocracy in this way. Indeed, in the latter part of the eighteenth century, the courts themselves were growing poorer and were becoming less able to afford such luxuries. If the ordinary man was going to a concert, he would have to pay for his seat, and he would often want his money's worth. He and his family would want to hear the music. Thus the instruments had to grow more numerous and, as we shall see all the way through this series, they often had to become louder, simply so that they should be audible.

An obvious way of making an orchestra more audible is to increase the size of the string band. When that happens, the woodwind are at a disadvantage, except on the rare occasions when the concert promoter could afford to double them up. Thus the woodwind had to grow louder. As they did so, they began to drown the strings, and there we go, well on our way to the Symphony of a Thousand.

With the increased number of string players, the cost of putting on the concert goes up. The obvious way of covering the increased cost is to build a larger hall to seat more paying customers. When you do so, the orchestra has to be larger so that it can be heard, and so we embark on the vicious spiral which still plagues us today. No concert with a name soloist or a name conductor can pay for itself in the Festival Hall, even if it sells out. This is why no major orchestras come to Oxford: we have no hall here which would even approach a break-even figure. This is why we put up with the echo in London's Albert Hall, why we have

halls like the Berlin Philharmonic where, from the top gallery, you feel that you are watching the orchestra through the wrong end of a telescope, and where even then the Berlin Philharmonic Orchestra needs an annual subsidy greater than the whole Arts Council grant for music.

Another effect of social changes in the eighteenth century was the freeing of social mobility within classes, though on the Continent perhaps the full effect of this did not take place until the latter part of that century with the French Revolution and the general upheaval of the Napoleonic Wars all over Europe. There had been what was almost a caste system; your father was a cobbler, and therefore you probably would be too, and in some parts of Europe, not probably but certainly. With this class freedom, the cobbler's son could chose his own trade, and, if he were musically inclined, he might become a musician, not just as an amateur in the evenings when he was free from his cobbler's last, but as a professional. The result of this change was the establishment throughout Europe of many of the musical conservatories which survive to this day, where any musician of talent could be trained to professional standards.

The earlier method of training had either been through the Church, or by apprenticeship, and even in the Church a form of apprenticeship was normal, although perhaps fairly open to entry by anybody with inclination and talent, unlike other apprenticeships. Entry into normal apprenticeship was often very strictly controlled. Restrictions on entry lasted longer in Germany

than elsewhere. In Germany, organisations such as the Trumpet Guilds were survivals of the old mediæval guild system. Entry was often restricted to the children, and especially the orphans, of guild members, thus prohibiting the entry of others into the musical profession. Sometimes others might play as amateurs, though the Trumpet Guild, at least, was powerful enough to prevent this. But they could never play as professionals, and even as amateurs, if they could not find a better amateur to teach them, they might never be able to progress beyond the stages attainable by the self-taught.

The advent of the Royal Academy of Music in London, which was a mid-18th century foundation, and then later the Conservatoires, Nationale in Paris and Royale in Brussels, and the similar organisations elsewhere, changed all that. Any boy, less often any girl, of musical talent could embark on a musical career.

As a result, the pool of available musicians expanded enormously in the nineteenth century. Even in England, where as we have already seen in other areas, things were much freer, if you look at the lists of musicians appearing at the various mid- to late-eighteenth century Festivals throughout the country, among the professionals the same names crop up again and again. It must have been very like the modern Early Music world, where each orchestra has a different name, but when you look through the names at the back of the programme, or at the faces on the platform, there is clearly quite a small pool of musicians available to share out among all the bands. In the nineteenth century this

changed. There were far more musicians available, and as a result, the various concert giving organisations did not have to pick a night when the Opera was not performing, to get an orchestra for their concert. In eighteenth century London, it must have been a bit like it was here twenty or so years ago, when nobody could perform *Bruckner 7* if the Garden was doing *The Ring*, because the Royal Opera House orchestra had the only set of Wagner tubas, and performances of Vaughan-Williams's *Sinfonia Antarctica* had to be planned to avoid *Turandot* because Covent Garden, again, had the only set of tuned gongs.

The change from private concerts to public had its effect on the musicians also. Composers, for example, found their lives very different. Where a composer had been the Kappelmeister to a court, so long as he produced his weekly concert, or whatever his contractual stint was, and as long as his own music, or the music that he borrowed in from his pals among the other composers, was to the liking of his Prince, his job and his meal-ticket were secure. As the private bands began to vanish, he became dependent upon the whim of the public, and while it may not have been easy to satisfy one Prince each week, it was very much harder to please every member of the concert-going public. Just as today, empty seats in the hall meant lower returns at the box-office. He could, of course, dedicate his new work to Prince this or Archduke that, and quite often such a dedication paid off in hard cash. Not always, though, and it wasn't really practicable to hawk a dedication round the local aristocracy to see who would pay the most

for it. Any of you who are putting on concerts can try Tesco for a sponsorship, and if they won't play, you can try Marks or the TSB. Beethoven couldn't really do that with a set of string quartets.

Thus a musical career became much more precarious, even for the most eminent composers, as Mozart, for example, discovered. There was no copyright protection in those days, which meant that anyone could bring out his own arrangement of popular works. There was no Performing Right Society either, so that a composer would only benefit from the public performance of his music if he was putting on the concert himself, or more occasionally if someone arranged it as his Benefit. His only income was from commissions, for example for a new opera, from his own performances, from grateful dedicatees, and from selling his work to a publisher. When he put on his own concerts, he took a chance on the number of tickets that would be sold on the night. If he got a good audience, fine. If not, he still had to pay for the hall, for the orchestra, and for all the printing and advertising. When he sold a work to a publisher, it was a cash down sale, with no royalties on future sales. This is why we have so many stories of how fast some composers could write; they had to if they were going to eat that week.

Soloists were marginally better off. As well as playing for their faithful local public, they could tour the other cities of Europe, either hoping that their reputation had sufficiently preceded them that local impresarios would pay them to perform, or putting on one concert themselves, just as young soloists put on a

Wigmore or a Purcell Room today, in the hope that they would make such a hit that they would then be taken up by the local concerts. They could also tour the courts, playing for Maria Theresa one month and for Marie Antoinette the next, and if they were lucky this could pay off in hard cash, but if, as more often, they weren't, it might be a ring, or an enamelled pocket watch, or a jewelled snuff box, and there are limits to the number of rings you can wear, watches you can pocket, or snuff boxes that you need, and anyway you can't eat any of them, and royal gifts are not safely saleable.

Orchestral musicians were certainly better off. All these circumstances led to more concerts, and more concerts meant more work. If you could play for Beethoven one night, Schubert the next, and Haydn the night after, their takings might have been down, but you'd had three gigs. More concert halls set up in rivalry with each other, each with its resident orchestra. In England, the provincial Festivals proliferated, and however much the local concert would of course employ the local talent, there was always the need for stiffening from the main London bands. To this day there are many orchestras with proud local names which nevertheless need help from the central London pool of musicians for many of their concerts. In my career as a professional musician, there were few provincial orchestras, including the BBC's, that I did not play in now and again. The same was true in the late eighteenth century, and in the nineteenth.

So much for an introduction to the changing patterns of musical life in the late eighteenth and the early nineteenth centuries. The rest of the lectures in this series will concentrate on how the Industrial Revolution, and the changes just outlined which it brought in its wake, affected the instruments with which music is made, and the ensembles which played them, and how this in its turn affected the music which is written, and performed on, those instruments, and by those ensembles.

We shall, in other words, see how musical sound changed from that of the early classical period into that which we hear in our modern-instrument concerts today, but perhaps as we go we may become more aware of the musical sound of each period. After all, music is sound – about the only thing in common between Mozart and some modern composers whom it might be more tactful not to name, is that both created sounds. When, as until very recently, we heard the same sound, if different music, when listening to Mozart as we did when listening to Stravinsky, we heard a falsification, just as we would see a falsification if we repainted a Rembrandt with the acrylic colours that some modern artists use. In fact, the Stravinsky we hear today is also often a falsification; the *Rite of Spring* was written for Paris, and all the French instruments in 1913 sounded very different from those in the LPO or whomever today.

These lectures were given at fairly short notice in the Faculty of Music, University of Oxford, in the early 1990s, and were therefore based on accumulated knowledge rather than specially

researched. Therefore no bibliography was provided. They were illustrated with instruments and by slides that cannot be reproduced here due to copyright restrictions – it is generally assumed that one can show things in a lecture but not publish them. However, many of them can still be easily found through the books cited, especially my own World of...Musical Instruments series, in particularly Romantic & Modern, here abbreviated as R&M.

2 The Organ

The organ was, of course, well-established long before the Industrial Revolution was thought of – it was invented around 200 BC in Alexandria in Egypt, and it was used by the Romans, mostly in the circus. Perhaps they used it rather as we used the mighty Wurlitzer in the cinemas in the 1930s to entertain the customers between the films, playing the hydraulis, the hydraulic organ, between the gladiators' duels, wild-beast hunts, massacres, and other entertainments. It's always been rather a surprise that it became a church instrument in the ninth or tenth centuries, because one would have thought that the memory of its use to accompany the massacres of Christians under Nero and other Roman Emperors would have been such a lasting memory that it would have been tainted beyond redemption. Still, it did become the church organ, and, with the beginnings of industrialisation in the 17th century, it became the large and elaborate instrument of Bach's period such as that in the Wenzelskirche, in Naumberg, which is dated to 1743-6, and whose specification was approved by Sebastian Bach. This organ has a pretty complex mechanism of rods, trackers, and roller-boards, linking three or more keyboards and a pedalboard to several thousand pipes, and also linking a number of pairs of bellows to several windchests and air reservoirs.

It was pre-Industrial Revolution technology that allowed the manufacture of the large pedal pipes. Organ builders were able to cast 16-foot pipes by the mid-1500s, and remember that that is

the speaking length, from the mouth to the top of the pipe, sounding the C an octave below the one on the second ledger line below the bass stave; any organ pipe needs a foot on which to stand, so that the 16-foot pipe has to be about 18 feet long or more. Before Bach was born in 1685, Arp Schnitger in Germany was building organs with 32-foot pipes, over ten metres long including the foot, and these, if fairly rare, were found on a number of large organs.

Ranks of organ pipes are named by the lowest C of that rank. If the lowest C was middle C, then it would be a two-foot rank. The C below, the second space in the bass clef is the four-foot, that on the second ledger line below the stave is the eight-foot, and so on down, or up, as the case may be. The length of the foot is purely nominal; it depends on the shape and diameter of the pipe, the pitch standard of that town, the air pressure used for the organ, and anyway the length of a foot has always varied from place to place and time to time; it was seldom if ever 30.8 cm long.

Such organs were still built all in one large case, so that the organist was, as it were, built into his organ. He sat on his bench with, behind him, the Rückpositif or back-positive which, because it was behind or sometimes even under the seat, was called the Chair organ in England, a name which became transmuted into the Choir organ. In front of him, immediately above the keyboards or manuals, was the Brüstwerk, which after 1700 or so might have been built into a box, with doors shutting it in, which could be opened or closed by a foot lever, the Swell. Above

the Swell was the Oberwerk and the Hauptwerk, which together were called the Great in England. Two side towers, or, and sometimes and, a central tower, contained the longest pipes, which were played by the pedals.

The main reason that all this was in the one case was that the operation, the transmission of action, between depressing a key or a pedal by the player's finger or foot, to opening a pallet or valve to let air into a pipe and thus produce a sound, was all by trackers and rollers, wooden or metal rods and wires which pulled, pushed or turned other rods to move further rods and wires to open and close the access of air to the pipes. The air was, of course, provided by one or more, usually more, people pumping on bellows which fed air to reservoirs and wind chests. You can't pump air directly from bellows into the pipes because if you do, the pitch sharpens as the pressure increases, and flattens as it slackens. The Greeks and Romans knew this: hence the hydraulis where the air-pressure was stabilised by the weight of water in a tank. It took most of a thousand years after the fall of the Roman Empire for this knowledge to be rediscovered in Western Europe, and the system that was then used was one of lead weights on top of the reservoir, rather than water. Provided that the feeder bellows keep air coming into the reservoir, the weight of the lead keeps the air pressure steady in the pipes. If you want to build an organ with higher air-pressure, you simply put more lead on the reservoir bellows; lighter pressure, less lead.

There were two main disadvantages of building the organist into the organ in this way and of this type of mechanism, known as the tracker action. One is that, in a good many styles of church architecture, the organist was a long way from the choir whom he was accompanying. Where there was a large organ loft, as in some German churches, he could have the choir, and even an orchestra, up there with him. The same applies to some designs of collegiate organs in Britain; there's room for quite a fair size orchestra and choir with the organ on the screen in Westminster Abbey, and I've often wondered why we don't have that provision with other screen organs such as King's College, Cambridge and St. Mary's here in Oxford – perhaps we like to be able to see the choir. In Spain, organs were often placed on each side of the choir, opposite each other. However, what was often the normal organ position, stuck against the wall at one end of the church, usually the west end, as far as possible from the choir, made any ensemble work pretty difficult, since the sound of the choir took a perceptible time to reach the organist, and he had to play ahead of them so that his sound reached them as they sang, far ahead of hearing them, several beats in any reasonably fast music.

The other was a matter of air pressure, spring tension and the weight of the action. The pallet is held closed by a spring so that when the player takes his finger off the key, it will close and the sound will stop. Opening a single pallet is no problem but play a four-note chord and you are opening four pallets, with four times the weight. When another stop is drawn to couple another

rank of pipes, two sets of four pallets are being opened and the weight doubles to eight times that of a single pallet. Since quite a number of ranks may be played simultaneously in normal organ music (the combination of several ranks is what gives organ music its colour and character), the weight on the keys, which must be overcome by finger pressure, can get pretty heavy. This was not too much of a problem in the Baroque, but with nineteenth century organ music, and perhaps especially in France where, even in the Baroque, a characteristic style of organ playing was contrasting a solo stop, which might be quite light in action weight, with the full organ, which could be pretty heavy, this was more of a problem. It was also a problem when air pressure was increased to get more volume (and to allow enough air for more stops) because one is opening the pallet against the pressure of the air inside it to let the air into the wind chest.

In the late 1830s, Charles Barker invented his pneumatic lever, a small bellows. The finger on the key opens a pallet and a puff of air operates the bellows and they do all the rest of the work. Thus the only effort by the player is opening the initial pallet, and the weight felt by the finger remains constant. This mechanism met with little initial success in Britain, but it was taken up by the great French organ builder Aristide Cavaillé-Coll who built many very large organs all over France. In 1845, Prosper-Antoine Moitessier invented his tubular pneumatic action which was combined with Barker's levers by Fermis in 1866 and by the great English organ-builder Willis in 1870. The tube can be as

long as you like, and thus it became possible to separate the keyboards from the pipework. Because it is possible also to use the pneumatic motor, as it is called, to replace any of the trackers, not just those between the finger and Barker's lever, the organ could be dispersed, scattered round the church, with the big pedal pipes, which had now reached 64 feet in length which, with the foot, is much the same length as a cricket pitch, sounding an octave lower still, placed in the dome, as at St. Paul's, in the triforium, or wherever else room for them could be found. In addition, because the pneumatic motor could be made as powerful as was necessary, air pressure could be raised to such an extent that pipes had to be wired down into their sockets to stop them from lifting off like moon rockets.

The final stage in these mechanical advances was the electro-pneumatic action, where the tubular part of the action was replaced by electricity travelling down wires. We have all fallen over the massive cable trunk, encased in flexible steel tubing, which links the console (the keyboards as a separate desk) with the rest of the organ. The electro-pneumatic action had the dual advantage of allowing the organist to sit wherever he wanted to, even in a different building, and removing some of the sponginess from the feel of the action. Playing a tubular-pneumatic organ is a bit like fingering a violin or a woodwind instrument through a pillow, whereas electro-pneumatic is a bit more immediate. Electro-pneumatic action nevertheless overcame only some of the delay inevitable in any pneumatic action; the motors take a perceptible

fraction of a second to function, and the puff of air takes quite a while, in musical terms where we can easily play 32 notes per second (demisemiquavers at crotchet 60) or even more, to travel down the tube. Electricity goes down wires pretty well instantaneously, but you still have a pneumatic action at the other end. This is why the latest development in organ building has been a return to the original tracker action which, with all its other disadvantages, is at least immediate, with a positive feeling of contact with what goes on.

Now, where does the Industrial Revolution come into all this? It comes in two areas. The first is the mechanical. These devices that we have detailed are all pretty complex. They depend, working backwards, on the development of electricity, on the development of suitable materials to make the tubing, and on all the small parts involved.

The second is the social. After all, if you have a village church and you want an organ for it, a small tracker machine works fine. It's the big city churches and the big city concert halls which need the big organs which need all this mechanism. I'm not saying that such developments were not inevitable; St. Paul's was a big city church long before the Industrial Revolution, and so was the Thomaskirche in Leipzig, where Bach worked. But the spread and the number of such churches increased enormously with the movement of population into towns which followed the Industrial Revolution. What came with it as a new development was the Town Hall organ, like ours here in Oxford, like Leeds, which was

a famous one, and what was in some ways the best-known of all, St. George's Hall in Liverpool. The organist there was W. T. Best, and he gave regular recitals, playing not only the organ repertoire which grew to suit this type of organ (Liszt, Bruckner, Reger, Saint-Saëns, César Franck, Messaien, to name a few composers at random), but he also played all the standard orchestral repertoire, overtures, symphonies, the lot, and a good deal of chamber music repertoire, Beethoven string quartets and so forth. There was no Radio Three in those days, no recordings, few orchestras, and not much in the way of public concerts. Mostly, if you wanted music you made it yourself, or you went to hear the band on the bandstand in the park (we'll come back to bands later on in this series), or you went to hear Best at St. George's Hall or whoever was doing much the same job, if less famous, in your local hall.

The nineteenth century brought about a further change in the design of organs, with the invention of stops, designs of pipes, which would, more or less convincingly, imitate the sound of orchestral instruments. This is not to say that string tone and so forth had not been used before; it had, of course, and flute pipes and trumpet stops were well known in the Baroque – the Trumpet Voluntary was written for the trumpet stop on the organ in imitation of the real thing, which is why the Clarke (or Purcell, or whoever wrote it) Voluntary, like several others, has a middle section which uses notes which can't be played on the natural trumpet. But these imitations got nearer to the real thing, just as in our own time the synthesizer has got nearer and nearer to

the real thing. Again like even the newest synthesizers, it was still quite a long way off, but if you'd never heard a symphony orchestra or a string quartet, this was not too serious a problem.

One result of all this was that hardly anybody was still building tracker organs. Even the small church organ was now fully mechanised, and therefore pretty expensive. This might be OK in most villages where there'd be at least one fairly wealthy family who would stump up for a new organ. One should remember that the life of an organ is pretty short; it needs renewing every 75 to 100 years, and anyway most English villages had lost their organs during the Commonwealth even if they'd managed to keep them through the Puritan campaigns of the Elizabethan period. The poorer village, however, depended on a small organ and, if no one could play the thing, on a barrel organ which only needed someone to turn a crank at a regular speed (that's harder than you might think). This would have a wooden cylinder with pins in it to raise levers to open the pallets. The pins have to be properly placed, but this is a job that can be done with a ruler, and one simply bought the organ complete with a set of barrels for the hymns that one preferred.

Even barrel organs were not as cheap as one might wish, for pipes are expensive, and even the smallest barrel organ had to have a couple of dozen or so, and barrel organs were, of course, limited in repertoire. A new hymn meant a new barrel, and if, as quite often, you had several hymns on each barrel, it meant that

their length was fixed; it was four verses or nothing. You could not leave one verse out or add another.

It may seem odd to say that the Industrial Revolution inspired religion, but it did. The various chapel sects, Non-Conformists, Dissenters, and so forth, flourished in the new towns and cities, fuelled often by the working men's clubs and classes with their libraries which brought new ideas and education to people who had had no opportunity for either before. Sometimes these sects had access to money and could build places like Westminster Central Hall, which has a cathedral-size organ (and an echo worse than the Royal Albert Hall), but far more often often they could only run to a small building, built by the pennies of its worshippers. Even a barrel organ was often beyond them.

The answer was a reed organ. The true organ reed was probably known in the fifteenth century and certainly by the end of the sixteenth. It had a brass reed like the cane reed of the clarinet which beat on the edges of the shallot on which it was mounted, and a pipe as a resonator. The free reed, which is so-called because a blade of brass, later of steel, vibrates freely to and fro in its slot and doesn't beat against anything. This came into Europe through Russia, initially on the sheng, the Chinese mouthorgan. It was used in some eighteenth-century East German organs to give an extra rank or two, and there were several ranks of free reeds in the very large organ of Leeds Town Hall, already mentioned, which when built by Gray and Davidson in 1857 with Barker's levers, had 6,500 pipes down to 32-foot plus the free-reeds which

also go down to 32-foot. It is now electro-pneumatic with a detached console which, I think, goes up and down on a lift like a cinema organ.

Later the free reed was normally built into a much smaller instrument. The harmonium, which blows the air past the reeds, was invented by Debain in Paris in 1840, and the American organ, so-called because it was much the more popular there, and which sucks the air past the reeds, a rather more stable process, was invented, also in Paris, by Alexandre. An instrument with the capacity of as many stops and ranks of reeds as those of the pipes of the range of quite a large church organ can be built into a case no larger than an upright piano, and cost less than the piano because the reeds were cheaper than strings and the mechanism was simpler. There were no pipes; the reeds were all that was needed to make the sound. Because the reed, a steel tongue in a brass frame, was small and took little space (a 16-foot reed for a harmonium can be smaller than my little-finger), instruments such as these were cheap enough for any chapel, however small and impoverished, and also for many parlours in the days when people were religious enough to have family prayers at home. Not just at home, either; portable harmoniums could be used by a street busker (we have one in the Bate), and similar instruments were used for revivalist services on street corners.

Nor were reed organs just for religious services either. Berlioz in his Treatise on Orchestration says that Alexandre's American organ is ideal for theatres and small opera houses.

Nor just for serious music of any sort. The free reed, being small, can be built into many portable instruments, from mouthorgans to squeeze boxes of all sorts. One of the inventors of the mouthorgan was Charles Wheatstone, the leading scientific inventor of his day, who was responsible for many developments in the use of electricity. He also invented a form of mouthorgan and the concertina, and for many years his firm made and sold concertinas, which were one of the most popular instruments of industrial urban life, as well as taking the place of the rustic pipe and tabor. Its big brother, the piano accordion, is thriving in all sorts of musical contexts. The larger accordions almost rival the harmonium in scope, for although they have short keyboards, they have a variety of stops to play up or down octaves, and although the keyboard is only for the right hand, they have a large range of chord buttons for accompaniment, each of which admits air to a group of three or four reeds.

Thus the Industrial Revolution not only made many of the developments of all types of organ possible, it also made them necessary, and especially did it influence instruments deriving from the organ or designed to replace it. If, as one might, one considers that the Revolution is still with us today, then we can see also the tremendous process in our time of the electronic keyboard instruments, both those which have replaced the organ in so many places (and rather more expensively than the harmonium) and those which are used in other contexts.

One of the results of the Industrial Revolution as it progressed was the greater mechanisation of production, so that where initially it demanded, and attracted, vast numbers from the fields into the mills and factories, later it threw many of those people out of work, replacing people by machinery, just as computer controlled machines are now replacing people in so many of our factories. Similarly, the synthesizer started to replace musicians in the orchestras, and the Musicians' Union has tried to play the rôle of the Luddite, attempting to ban its use where it puts a musician out of work. As a good Union member, and professionally a percussion player, I object to the use of the drum machine myself, but luckily so do most other people because one doesn't often want to play along with a metronome. Because the synthesizer is now coming of age and, instead of spending all its time imitating real instruments which can still do the job better, it is creating new sounds and new ranges of sound, no ban will ever succeed, and in fact we seldom go into the studio without seeing at least three or four of the things.

Being an electronic ignoramus, I don't intend to go into any detail of how the things work. I am more interested in how they were, and are, used, and their musical effect. Certainly, in their early days, they were mostly used as imitators. First, with the Hammond organ for example, they were substitute organs for churches, and also the home, just as the harmonium had been. Then, with the Moog, they were imitating other instruments — "Doesn't this sound like a harpsichord?" was the cry — the an-

swer was “No, not very”. Then we got the machines which included recorded snippets of every sound that an organ could make, and which put these sounds out again on demand, sounding rather more like a real pipe organ, but still not exactly. With the improved synthesizer, imitation really came into its own as long as you forgot just what a human player could do with the real instrument, and usually just how one note linked to another, which is something that the electronic instruments have never been good at imitating. But this was really playing, in the toy sense, and while the synthesizer and other electronic instruments are still useful in the Palm Court or equivalent places where it is useful for one player to be able to substitute for a variety of other players, on the whole the synthesizer has put its childhood behind it, and is now being used as an instrument in its own right, a rôle which is only limited by the imagination of the player.

There is, too, one real value in its rôle as an imitator. Just as the Industrial Revolution brought the piano into so many homes in the last century, so the electronic keyboard has gone into the homes of our time. It may spark off a musical revolution, too, for the domestic piano had gone out of fashion, and many homes were without an instrument in the middle years of the twentieth century that now have one again. We may, once again, see the revival of music-making in the home which was such a feature of the nineteenth century.

3 The Piano

The first trace of the piano, by which I mean a string instrument struck with hammers by a keyboard mechanism, comes in about 1440 in Arnault de Zwolle's manuscript in the Bibliothèque Nationale in Paris (there is a facsimile, edited by Le Cerf and Labande). He explains that the dulce melos, a form of psaltery or hammer dulcimer of that period, can have a keyboard and either have its strings plucked like a harpsichord or struck with a form of hammer, which can be seen on the extreme right of Arnault's harpsichord plan. Because there is no other evidence for this instrument — nobody else describes it in writing and nothing like it appears in any other illustration of the period — it is generally assumed that it was unsuccessful. The reason for its lack of success is fairly obvious. If you pluck a string with a quill, the quill passes the string at the instant of pluck and the string is left free to vibrate. If, on the other hand, you strike it with a hammer, the hammer stays briefly in contact with the string and blocks it, deadening the sound, unless you can build in some mechanical equivalent of the human relaxed wrist.

The mechanical relaxed wrist, the escapement as it is called, was not invented until just before 1700, when Bartolomeo Cristofori devised his *gravicembalo col piano e forte*, a harpsichord with soft and loud. The fascinating thing about Cristofori's invention is that he had devised the lot — it was not a question of adding improvements, over the next century or two, to make his instrument

work properly, but of rediscovering and reinventing all Cristofori's devices which the next generation of makers were too lazy, too ignorant, or working too cheaply, to fit in their instruments. It was not until the nineteenth century that the increasing weight of hammers and the increasing string tension and mass meant that new devices were really necessary.

There are only three of Cristofori's instruments surviving: one in Rome, one in New York, and one in Leipzig, and each is slightly different mechanically. In the 1726 piano in Leipzig, the last of the three, the escapement is achieved through the jack and the block under the intermediate lever, which slip free from each other. One of the other problems of the piano, once one has devised a way of separating the hammer from the key so that it can escape and fly freely, is the tendency of the hammer to bounce up and down as it falls back, and have a second or even a third crack at the strings. This is prevented here by the check, which the hammer falls back against — the friction between the two is enough to kill any bounce.

Another problem, with any horizontal piano pattern, is the tendency for the hammer, as it strikes the strings from below, to knock them upwards and dislodge them from the nut, the cut-off bar which defines their length at the nearer end, that nearest the hammers. Cristofori avoided this by inverting the wrest plank, which carries all the tuning pins. Instead of the tuning or wrest pins sticking up from the wrest plank, they were driven right through it so that the strings could be attached to the lower end of

the pin, and the nut was also on the lower face of the plank. Thus the hammer seated the strings more firmly on to the nut instead of lifting them off. The nut cuts off the vibrating length of the strings at the far end, and beyond that the hitch pins on their own rail or plate have the end of the strings round them.

His design of the hammer itself went through various stages. The 1726 pattern, a roll of parchment with a soft leather pad, which is both springy and efficient, was the model for several later makers. He also provided an efficient damper system, using a device rather like a harpsichord jack which was pushed up by the tail of the key and which fell back when the key was released to stop the vibration of the string. There was no damper lift (or loud pedal) because changes of sonority were not a custom with Italian harpsichords; they did not usually have stops to vary the sound like Northern European instruments.

Cristofori also realised, or perhaps discovered, that hammering does not really suit the light strings at the comparatively low tension which was characteristic of the harpsichord, and it is assumed that he must have used either heavier strings or higher tension, or maybe both, because, unlike the harpsichords of his period, he provided spacing bars across the gap between the wrest plank and the soundboard — there must be a gap so that the hammers can come up and strike the strings, just as the harpsichord had a gap where the jacks were. With increased tension, there is a tendency for the wrest plank to be pulled towards the soundboard, or vice versa, especially with the very light casework typical of

the Italian harpsichord, which would jam the action, and indeed this was the main bug-bear of piano makers until, as we shall see, the invention of the complete iron frame by Babcock in 1825.

Accounts of this instrument reached Germany from Mattheson's translation in 1725 or so of a somewhat cursory description and drawing of Cristofori's first model by an Italian journalist, Scipione Maffei, and Gottfried Silbermann started making pianos based on this in the 1730s. He showed one to Bach, who liked neither the action nor the sound. The hammer here is a solid block, which probably made too hard a sound, and the check is a pair of crossed threads, which would not be very efficient. There is no intermediate lever between the jack and the hammer, and this would reduce the speed and force of the hammer. An improved design, probably based on having seen a Cristofori instrument rather than relying on a poor drawing and a second-hand description, was more successful and this was bought by Frederick the Great, where both J. S. Bach and C. P. E. must have seen it in his music room. Silbermann provided two hand stops to control damper lifts, splitting them at middle C so that one could have either the bass or the treble free, or both, and also a una corda. The una corda pedal or lever shifts the keyboard slightly sideways so that the hammer strikes only one string instead of both of them. The split damper lift remained a common feature on many later eighteenth-century square pianos, as can be seen in the Bate Collection.

The French harpsichord maker Marius is sometimes credited with producing a piano between Cristofori's and Silbermann's, but his instruments were never successful because they had neither escapement nor dampers; his first model had the hammers fixed to the keys so that it was little more than a clavichord with hammers instead of tangents, a type of instrument sometimes called a tangent piano, and would depend on the player releasing the key very quickly, with a very staccato action, to avoid blocking.

One reason that Cristofori's, and Silbermann's, pianos were not widely popular is that they allowed a keyboard instrument to do something which was not really needed, for their essential quality of expressiveness was not yet widely required. This is probably why a number of the Cristofori pianos, which had been bought for the Spanish Court, were converted into harpsichords after a few years, and why so few survive. Later in the eighteenth century, from about 1750, a number of factors combined to favour the pianoforte:

1 Expressiveness in music became fashionable with the new Rococo style — crescendo & diminuendo, piano & forte, and all the intervening gradients of dynamic were required;

2 The desire for a small and expressive keyboard instrument for domestic use, which would be louder than the clavichord;

3 Technological improvements, due to the Industrial Revolution, became available which would overcome the main deficiencies of the piano — covered strings and heavier strings which

would withstand higher tension, and which would be more suited to the hammer;

4 Changed conditions of concert giving, and the growth of the concert hall, where more sound was required.

The second of these, the desire for a small and expressive keyboard instrument for domestic use, which would be louder than the clavichord, led to the development of small rectangular instruments, the so-called square piano which replaced the clavichord to some extent in Germany, and replaced the spinet in England amd France. This led, in the interests of simplicity and cheapness, to some fairly grotty mechanisms, such as the simple Prellmechanik without escapement but with a knee lever as a damper lift. The Prelleiste is the bar or ledge which catches the beak of the hammer and flips the hammer-head up. A much better action was that used by Zumpe and other immigrant German makers into England in the 1760s, where a sticker on the key flips up a hammer which is quite separate from the key itself, as it was in Cristofori's action. It was this type of action which was used in the pianos which J. C. Bach made so popular here in Britain.

However, this was still comparatively crude, and a much better action is thought to have been developed by Johann Andreas Stein in the 1770s. This was a greatly improved Prellmechanik with an escapement, and it was this action which so impressed Mozart and for which he wrote so much music.

The piano was still comparatively lightly strung, and it is instructive to hear one of the double concertos for harpsichord and

piano, which a number of composers of this period wrote, played on instruments of the period. The problem is not that the piano may drown the harpsichord unless it is tactfully played, but that the harpsichord does drown the piano. The bass strings of the piano were lightly covered, with an open winding of thin brass wire over the brass string. With the increased technology which became available, a closer winding, and later an iron core, replaced this, and as a result of these heavier strings, their tension increased and at last hammering became more efficient and the piano became a really effective instrument. The sort of piano which the Royal Philharmonic Society of London presented to Beethoven when he became too deaf to hear much from the Stein type of instrument was made by Broadwood, with a more efficient action, heavier strings, and, to make those heavier strings vibrate properly, heavier hammers.

For a long time, the Viennese stuck with the Prellmechanik, though it became more efficient and sufficiently louder than the English action that Beethoven switched back to local talent. Eventually they gave up the Prellmechanik, though some continued with it on cheaper instruments well into the twentieth century, and turned to the conflation of the English and the Continental action devised by Streicher in 1831.

The most important step forward in mechanical development was Erard's invention, in 1821, of the double escapement and repetition action. With all the actions that I have mentioned so far, the hammer falls right back to the check and if, as so often, one is

playing a series of repeated notes, each requires the full strength of the finger or hand (think of Schubert's *Erlkönig*). With Erard's action, the hammer falls back only a short way until the finger leaves the key, so that repeated notes require much less effort. It was this action that Chopin and Liszt were writing for.

By this time, the range of the instrument was increasing, as can be seen by studying both extremities of the range in Mozart's, Haydn's, Beethoven's, Chopin's and Liszt's piano music. It is important to remember that the bass was much clearer in sound than it is today; the critics who say that Beethoven's bass writing was poor because it is so confused and muddy, are criticising the tone quality of the modern piano, not Beethoven's writing. Hear it on a contemporary instrument, and it's clear enough. Equally, the writing in the treble did not sound as much like a xylophone as it does today.

All this time, too, the stringing was growing heavier, as were the hammers. The greater tension was pulling the instrument apart, distorting it, and closing the gap where the action is. We have already seen Cristofori's wooden braces across that gap; late eighteenth and early nineteenth century makers used rather larger iron braces of similar form, as well as heavy internal wooden struts and bars. Broadwood took a major step forward in 1827 by fitting iron struts from the wrest plank to the hitch-pin plate, which was also of iron. However, two years earlier Alpheus Babcock had found the true solution in Boston: the whole iron frame. This is a single casting, incorporating wrest pin plate, hitch pin

plate, and side members, all in the one piece of iron, so that there was no dependency on the rigidity of screws or bolts into the wood, as in the Broadwood patent, and no worries about the wood moving beyond or within the barred area. Chickering produced a similar plate for a grand in 1843, and Steinway produced an improved model for a square in 1855, following this with one for a grand in 1859. Despite Babcock's and Chickering's work, none of the pianos at the 1851 Great Exhibition had such frames; there was nothing more advanced than the Broadwood. However, such plates became reasonably common not long thereafter, though cheap wood-frame instruments continued to be made for domestic use into the twentieth century.

We have got most of a century ahead of ourselves in the use of the instruments. J. C. Bach introduced the piano to London, playing a grand, one presumes, at his Bach/Abel concerts, perhaps a grand by Merlin who was said to be the first maker of grandpianos in London. For domestic use, Zumpe, Pohlmann, Adam Beyer (one of whose squares we have in the Bate), and others produced a flood of small squares. The harpsichord makers, naturally, objected to this and tried to update the harpsichord, making it go against its own nature of clarity and terraced dynamics by providing a swell, either by an inner lid with a series of slats like a Venetian blind, as we have in the Bate, the Venetian Swell, or by lifting part of an inner lid covering the short straight side and a bit of the bent side, looking rather like a horse's head and therefore called the nag's head swell. The main effect of the swell was to throt-

tle the sound unless the swell was opened — it made the normal sound quieter, with the possibility of becoming louder. The swell is operated by the right pedal. The left operates the machine stop, which acts rather like an organ preset and gives a quick shift from one sonority to another. Some makers used knee levers instead of pedals, but either allows the player to make a change without taking a hand from the keyboard to move a stop. Neither of these expedients was that successful. Some people continued to buy or play harpsichords; why else were most Beethoven Sonatas published as for pianoforte or harpsichord? Of course to sell to anybody who wanted to play them, whatever instrument they had. Before long, Broadwood had given up making harpsichords (his last was made in the 1790s) and turned to pianos, both grand and square, as had other makers.

The great advantages of the square piano are that it was small and cheap, that it could be put anywhere in the room, and that the player could see the audience over the top. The upright, which was common from the latter part of the eighteenth century, was unstable and only safe when placed against a wall, and the player had to have his or her back to the audience. The great advantage of the upright was that it was a grand with a full-size soundboard and full-length strings, bent upwards in a right-angle at the keyboard so that the soundboard and strings went up instead of away. The action was not particularly complex; just rather inefficient due to the tendency of the long stickers, that led from the key to the action, to warp or jam with changes in humidity, and

the instrument itself was inherently unstable due to its height and narrow base. John Isaac Hawkins, in Philadelphia and Matthias Müller in Vienna both had the idea, around 1800, of rotating the instrument through 180 degrees so that it projected downwards instead of upwards, and this became the basis of the modern upright. There have, of course, been many more varieties of both high and low uprights, giraffes, pyramids, cottages, and many others. Robert Wornum produced the first cottage upright in 1811, and he patented what is still the basic modern upright action in 1842.

Height, in the upright, and length, in the grand was saved by the invention of overstringing in the late 1850s, slanting the longer strings across the shorter strings so that, being on a diagonal, longer strings would fit into a shorter space. Length was further saved by using heavier strings, overspinning the strings, which were by now of steel, with a binding of copper wire, and often with a second overspinning. Both the accurately drawn steel strings and the technology of overspinning were, like the cast-iron frame, products of the Industrial Revolution. Iron wire had been used on harpsichords and this was sometimes case-hardened and was, anyway, hardened to some extent by being drawn through progressively smaller dies, but the commercial production of steel depended on Bessemer's process.

The use of such strings demanded heavier and heavier hammers, as we have already seen, and their success demanded new materials. It is said that Henri Pape, in Paris, looking for a reli-

able, but softer, substitute for the old leather hammer, tried chopping up some hats and so devised the first felt hammer. As hammers got heavier they increased the tendency to lift the strings off the nut. Cristofori's inverted wrest plank was long forgotten, and the down-striking action, which had been tried by various makers, was never really successful due to the difficulty of devising an efficient way of getting the hammers up off the strings after striking them. Erard patented the agraffe, a small metal block drilled to pass the strings through it, which could be screwed to the wrest plank and which would hold the strings down. Most makers took this up, though some used Bord's capo tasto, a bar running across all the strings to hold them down.

The use of heavier hammers also increased the weight of the action, which is why Chopin, when playing in London, asked for a square piano instead of a grand — the English grands had a heavier action than the Erard to which he was accustomed. I had never believed this, though it was Hipkins, Broadwood's tuner who tuned for Chopin, who recorded the statement, because I could not believe that Chopin would have tolerated the typical English square with its tiny soundboard and feeble tone. However, a few years ago, Bernard Rose presented the Bate with a Broadwood model I'd never seen before, with the keyboard projecting outwards, instead of being inset, and thus with a much bigger soundboard area, and with Broadwood's patent bars separating the wrestplank from the iron hitchpin plate. This was built in 1844, just about the time that Chopin was here, and if you want

to hear what Chopin's music sounded like, come in to the Bate and try it. What is particularly important is the light damping, which means that the sound dies off slowly, instead of being chopped off short, when the key is released, and one needs the pedal much less than one would think. This could explain why there is so little pedalling marked in many of Chopin's original editions — much was added later to suit the modern heavy dampers, which abruptly chop off the sound.

By about 1870, the piano had reached something like its modern action, and the sound which was prevalent up to about twenty years ago. Brahms is probably the last composer for whom one ought to look for a period piano to appreciate the precise sonorities for which he was writing. Don't be fooled by any of the "But surely [whoever we are talking about] would so much have preferred the wonderful sound of the modern piano." Maybe he would, but he would have written different music for it, music that would have suited it, rather than the instrument he did write for. The tone quality has deteriorated in the last twenty years, the modern Steinway having much harder hammers and a tone which is also hard. The string tension has reached the point where the strings, instead of having harmonic overtones as a string normally should, are almost as rigid as bars, and therefore they have overtones which are not harmonic and which muddy the sound. These inharmonic overtones jar on sensitive ears and on ears which have become accustomed to the sound of harpsichords or early fortepianos. This is why players such as Melvin Tan have turned away

from the modern piano for Mozart and Beethoven, and why they are beginning to look for appropriate pianos for Chopin, Brahms, Schumann, and Liszt.

This is, perhaps, the Leitmotif of these lectures: music is sound, and one should seek to recreate the sound which the composer heard himself, and the sound which he imagined in his aural imagination, when he wrote those dots on the paper.

4 Exotica

One of the inevitable results of the Industrial Revolution, which, with its mills and factories, enabled the manufacture of things in large quantities, is that you have to have much larger sources of raw materials than before. Another is that you have to sell the finished products. The result is Empire.

In the course of establishing the Empire, inevitably one meets the local musics, and even if, as very often, these are regarded only as funny noises, some of those noises will make their way into main-stream music if only as local colour. In addition, travel to the outposts of Empire is often thought of as romantic and exciting, and so a concept of the excitement and romance of the exotic, even if only of the folk music of the further flung parts of your own country, creeps into music. Late nineteenth- and early twentieth-century music is littered with examples: *Casse Noisette*, *Capriccio Espagnol*, *L'Arlésienne*, *Turandot*, *Turangalīla*, I could go on and on. All these examples include instruments imported specifically for local colour.

As trade progresses, the concept arises of Trade Fairs, World Fairs, Great Exhibitions, and similar jamborees, at which the trading nations can compare their products, and at which the Third World can show off whatever it thinks the richer countries might be sucker enough to buy. Musical instruments often turn up in both categories, and indeed it was from such a source that Debussy got many of his ideas. As the Empire starts to disintegrate,

it becomes important to maximise sales abroad, and then apparently eminent, or anyway impressive, people get sent on prestige trips to distant places. Sometimes these are composers, and sometimes they bring back ideas, as Benjamin Britten did, for example, with his use of the Nōh play for *Curlew River*, and some of the orchestral devices in his ballet *Prince of the Pagodas*.

But let us look first at raw materials. One of the essentials for the cloth trade is a good supply of reliable dyes. Before the invention of the chemical or aniline dyes, all dyes were natural, made from woods, earths, insects, seeds or whatever. One important red dye was made from Brazil wood. Somebody discovered that this wood which, because it was shipped from the port of Pernambuco was also known by that name, was an ideal material for fiddle bows, and thus revolutionised the sound of the bowed string instruments. Pernambuco is a dense, hard wood which, once bent into shape, holds that bend. It is close-grained but not too straight-grained so that, while like any wood it can split, it is less likely than most to split along the grain. Thus bows could be stronger, they could be a better shape because one can safely carve a head at the point which, with luck, won't snap off, and because one can set a spring into them which they would retain. The result is that the sounds they produced could also be stronger. That's just one example, and one that came about purely by accident, but it resulted in a total change of style in string playing, particularly in strength of stroke at the point of the bow, in dy-

namic range, in attack, and in such effects as staccato, spiccato, and so forth.

In England it was Dodd, and in France the two Tourtes, father and son, who revolutionised the design of bows for the violin family towards the end of the eighteenth century. In the early seventeenth century bows had been made of such woods as snakewood, which is also from South America, but from Surinam and Demarara, which were opened up to trade rather sooner than the hinterland of Brazil. These had been a straight, or even outwardly curved stick, coming down in a gentle curve to a point, with a frog that clipped in, between the hair and wood. During that century, new devices were created to tension the bow hair such as the crémaillère, a metal bridle that engaged in one of a selection of notches. This was followed by the screw frog, which is still used today. This is quite a complex device, as can be seen in the William Retford display in the Bate Collection, where all the separate parts and the various stages in making bows and their bits and pieces are on display and described in the bow-making handbook, but nobody seems to know who first thought it up, nor even when. Some bows, which date from around 1700, already have screw frogs, or perhaps I should say that it is thought that the screw frogs, which they have now, may be original.

The reason for making changes to the point of the bow are that with the old bow, the hair is very close to the point, which is OK for quiet passages but does not allow for fortes; the hair is never so tight, even with the screw frog, that it does not give a

bit with the pressure on the string. At first the curve of the stick was steepened to the point, but this was not really successful and looked ungainly. Then the shape of the point was changed, dropping down in something that is often called a hatchet-head or axe-head. Because the backward facing point of the axe wasn't achieving anything, that was smoothed off, and the modern pattern arrived at. The camber or curve of the stick was also changed, with an inward camber, curving the stick towards the hair in the middle. This greatly strengthened the bow, and allowed the use of the *coup d'archet*, the strongly crunched chord which was often written at the beginning of a piece of music and was designed to shut up the chatterers in the audience and persuade them to pay a little attention to the music. At the same time, the bow lost its ability to play three-note chords smoothly; four-note chords, even with the softer bow and flatter bridge, had always been difficult and needed spreading; now three-note chords had to be arpeggiated as well. It is seldom possible to make any change which leads to an improvement in one respect, which doesn't produce disadvantages in another.

Modern technology is now making further changes to the bow, which may well become generally adopted due to economic and other changes. Pernambuco is a tropical hardwood which comes from the rain forests of Brazil, and we all know what is happening there. It is not impossible that within the next decade there simply won't be any pernambuco available, for the one thing that they're not doing is farming the forests, replanting, reseed-

ing, as they destroy them. A Swiss firm has produced a new bow material, using graphite fibres, instead of the natural cellulose fibres of wood, in a carefully planned design. We were recently presented with two examples of the Von Bennigsen bow. I'm not a string player and can't judge them, but they are here in the Bate Collection, and they can be tried and used. Certainly if pernambuco vanishes, some substitute will have to be found; whether this is the bow of the future or whether something better will appear, only the future can tell. But here is an example of modern technology coming to the rescue of a vanishing material, something that we shall see more and more often as time goes on and as we endeavour to destroy this planet on which we live and its resources.

Woodwind reeds, for example, badly need a new material, as we shall see when we get to that subject. Makers of reproduction early instruments are having to look for new materials to replace the ivory rings, ferrules and other parts of Baroque and Classical instruments, as piano manufacturers must do for their keyboards. The heavier brass instruments are now being made of fibreglass, not because of any shortage of brass but to allow American high school children to march with them. We shall meet many other examples. But let's go back to where we were.

The other changes which affected string playing were due to changes in the instruments, and these we will leave until the session on string instruments.

Materials from abroad affected keyboard instruments as well, though they made more difference to their appearance than to their sound. Whereas the earlier harpsichords were often painted, in France, or decorated with patterned papers, in the Low Countries, to cover the fact that they were made of ordinary timbers, the later ones, especially the eighteenth-century English instruments, were made of, or at least veneered with, mahogany, like any other furniture of the period. Mahogany comes from the West Indies and is said to have first arrived in Britain in 1724. It was not used wastefully, for it was never a cheap wood; the straight side of both harpsichords and spinets, which was normally placed against a wall, was usually left plain, without veneer. The keyboards also changed; as trade opened up with the Ivory Coast of West Africa, the old boxwood naturals gave way to ivory.

The ivory trade was an important one, if somewhat unsavoury, for an alternative name for the Ivory Coast was the Slave Coast, and many fortunes were made by exchanging cheap cotton goods, beads, mirrors, and guns from factories in the Midlands for ivory and slaves; one of the leaders in the anti-slavery campaign was Granville Sharp, and we have in the Bate Collection six of the instruments which are shown in Zoffany's famous painting of The Sharp Family making music on their barge, including the two one-hand flageolets which Granville Sharp is holding.

Ivory was an important material for all instrument makers. As well as key-covers for harpsichords, spinets, and then pianos, it was often used as a decorative feature on string instruments and

bows. It was widely used for the strengthening ferrules on the ends of the joints of woodwind instruments, and, for the richer customer, for whole instruments. Because it is very smooth and pleasing to the lips, it was also used for recorder beaks and flageolet mouthpieces, and occasionally for clarinet mouthpieces, and quite often for mouthpieces for brass instruments, especially serpents and, in the earlier period, for cornetts.

Woodwind instruments are made in separate joints or sections for a number of reasons; partly for tuning in that one can swap a longer joint for a shorter, partly for portability, principally for ease of manufacture in that a shorter tool in the bore works more accurately than a longer one. These joints fit together with a male tenon on one fitting into a female socket on the next. The socket is always at risk from cracking, partly because the wood is thin at this point, and partly because, if one pushes the tenon in slightly off the straight, one is putting a lot of strain on the socket. A ferrule round the end of the socket strengthens it, just as a ring round the end of the bell strengthens that. On very cheap instruments, the ferrule was sometimes a brass ring, but on most it was ivory, or occasionally silver; instruments which are made wholly of ivory usually have silver ferrules, unless they are really expensive, when the ferrules may be of gold. Almost all our flutes up to the 1830s or 40s have these ivory rings. Replacing these, when they are cracked or missing, is now becoming a problem, for none of the plastics that they've come up with yet really looks like ivory, and none have the same weight, which affects the bal-

ance of the instrument. More seriously, especially for recorder beaks, most of these ivory substitutes are made of resin which feels sticky, especially in the mouth.

An instrument wholly made of ivory was, we think, more often made for the wealthy amateur than for the professional, for ivory produces a harder tone than boxwood, which has a very sweet sound. This may explain why there are far more ivory flutes and recorders than other instruments; neither the oboe nor the clarinet were as popular with amateurs as the flute. Boxwood, which in the eighteenth century was mainly imported from Turkey, is very unstable with any variation in humidity, and this is why some makers, as early as 1700, were using ebony, which comes from Mauritius, India, Ceylon and the East Indies. A prime example of conspicuous consumption for the wealthy musician is our Richters oboe. This dates from about 1700 and is made of the best quality ebony, probably from Mauritius, where the best comes from, with silver keys and ivory mounts. The ivory is beautifully decorated, for ivory is the ideal material, better than any of the exotic hardwoods, for work in the very slow-turning rose-engine lathe.

When boxwood really became a problem was with the development of modern keywork in the 1820s and 30s. Cornelius Ward, who was one of the first to use long articulated levers for his keywork, examples of which we have in the Bate Collection, described it as more suited to a hygrometer, a device for measuring relative humidity, than for a musical instrument, for with his key-

work, which was particularly delicate and finely made, and with that of Theobald Boehm, as the wood expanded and contracted with changes in atmospheric humidity, the keywork either came out of articulation or jammed.

As a result, makers turned to rosewood and cocus, which are tropical hardwoods which are more stable than box. Cocus is a West Indian wood, and rosewood, which is also known as jacaranda or palisander, came mainly from Brazil, though it does also grow in Africa. Eventually African blackwood, a rather second-rate variety of ebony, with more open pores, not unlike a rather blacker rosewood, but heavier and harder, came into use. African blackwood was initially more popular in Germany than in France and England in the latter part of the nineteenth century, but this is probably because it comes from East Africa, and in the European carve-up of Africa in the nineteenth century, the Germans got most of East Africa, though we took it over after the First World War. It's also heavier than cocus, which makes it more difficult to hold up sideways, so it remained less often used for flutes than for clarinets, and it was hardly ever used for bassoons, any more than boxwood had been, for that also is too heavy for so large an instrument. Supplies of African blackwood are now threatened, just as pernambuco wood is, and what the clarinets of the future are going to be made of, as yet we don't know.

Rosewood and cocus, which come from South America, had been used in the eighteenth century as alternatives to box, and

rosewood also as an alternative to mahogany, but South America had been opened for trade much earlier than Africa. The African colonial powers had been content to take whatever came down to the coast, and there was very litle penetration of the inner parts of the continent before the middle of the nineteenth century. This was partly due to climatic differences, but partly also to different approaches to Empire between the Germans and us, on the one hand, and the Spanish and Portuguese, on the other. The Conquistadors went to the New World to settle it, to develop it, and also to convert its population to Christianity. We and the Germans tended much more to think of exploitation rather than settlement, and our missionaries tended at first not to go much further than where the exploiters were settled, on the periphery, where trade could come to them. When the centre of Africa was eventually opened up, it was to a great extent due to the journeys of such missionaries as Dr.Livingstone.

We shall go into this question of materials for woodwind rather more fully when we are discussing those instruments, but let us turn now to the influence of exotic musics. As an interest, this is apparent even as early as 1619, when Praetorius in his illustrated encyclopaedia of musical instruments, Syntagma Musicum, illustrated instruments from Africa and the East. He did not always get the attributions correct; his Javanese gamelan, copied from a Dutch book on the East Indies, is captioned as American and his West African pluriarc as Indian, but his woodcuts are very accurate and one of his drums, for instance, can be matched ex-

actly with one in the Ashmolean Museum where it was part of the original Tradescant Collection when the Ashmolean Museum was founded. Mersenne in 1636 shows a Siamese mouthorgan, an Indian vīnā, and a Persian saz. These did not really impinge on music or musicians, and this did not come about until, in the latter part of the eighteenth century, it became fashionable in military bands to ape the Turkish invaders of Eastern Europe.

This applied chiefly to the percussion; nobody was going to bring back the shawms which had died out a century earlier, but the bass drum, cymbals, and triangle became a feature of the *Military Symphony*, *Turkish Suite* (by Michael Haydn), and *The Elopement from the Seraglio*. The bass drum was, like the Turkish davūl, longer than it was wide, and it was played in the Turkish style with a wooden beater on the strong beats, and a birch switch on the off-beats; this is why the stems of the notes are either upward or downward, to indicate the two different beaters. These sounds were often imitated on the piano, with a pedal which struck the underside of the soundboard, and a built-in cymbal or triangle; Mozart's *Rondo alla Turca* and Schubert's *Marche Militaire* were meant to sound a bit different from the way we usually hear them today.

It was from this source, and this tradition, that these percussion instruments came into the opera orchestra. The military band is often much more up-to-date than the orchestra, and the opera usually ahead of the symphony. Both strive for effect, much more than symphonic music does, or at least until very recently,

and this is why the exotic so often appears first in the band and in the theatre. I have a suspicion, too, that extra musicians were imported into the opera from the military band, and that their instruments may have come with them — this may be why Mozart uses clarinets so much more often in his operas than he does in his orchestral works for the symphony orchestra; he had used them in most of his military band music, the wind octets.

Apart from these military instruments, it was not until the middle or second half of the nineteenth century that the exotic came into mainstream music. Berlioz, with his *Carnival Romain*, Bizet with *L'Arlésienne* and *Carmen*, Tschaikowsky with *Casse Noisette* and its exotic dances from Arabia and China, and his 5/4 scherzo in the *Pathétique*, which is based on a folk tune from one of the further parts of Russia, Rimsky-Korsakov with *Capriccio Espagnol* and *Scheherazade*, all show the very obvious signs of fascination with the exotic. Folk music, as in the *Pathétique*, was a rather earlier influence; Haydn shows signs of having heard Slovakian folk music, as does Brahms — it is surprising how much of Brahms's music can be rebarred to show the same rhythms as Bartòk writes out as 2+2+3 or 3+3+2.

The most obvious signs of the exotic are, of course, the instruments in the works I've just mentioned and others. The attempts at different scalar systems came later on, when the structure of music, as it had been known, was beginning to break down. An early example was Debussy's whole-tone scale, which was an attempt at reproducing the sounds of the Javanese gamelan, whose

slendro tuning, one of the two pentatonic tuning systems used there, is close to a fairly equal tone-and-a-quarter per step (about 240 cents), and also perhaps Siamese music, where seven equal steps of about three-quarters of a tone are used (about 171 cents). This was carried much further by Haba and others after the First War, but I don't think that the quarter-tones were any attempt at the exotic. In fact, at the 1932 Congrès de Musique Arabe in Cairo, there were vehement arguments between the Arabs and the European Arabists as to whether the European quarter-tones were the same as the microtones of Arabic music, with all the Europeans strongly arguing that they were not. Nevertheless, one of the quarter-tone pianos which were made in Berlin for Haba's music, wound up in Cairo, where I saw and played it in 1948.

We have gone, in the twentieth century, much further than the nineteenth-century composers in our search for exotic colours, not always very accurately. Puccini uses tuned gongs in *Turandot*, though that's set in China and the tuned gong culture is South-East Asia and Indonesia. Vaughan-Williams took them over in his Sinfonia Antarctica, but this was just for the sake of their sound, and this is what has happened to many instruments which were initially imported to sound exotic. Take, for example, the instruments of *Capriccio Espagnol*. The tambourine, which Berlioz had used for its Italian connexion in *Carnival Romain*, Tschaikowsky for its Arabic flavour in his *Danse Arabe*, and Rimsky-Korsakov for its Spanish connotations, simply became another percussion instrument. The castanets, on the other hand, remained firmly

Spanish until much more recently. The cymbals, bass drum, and side drum had already become normal orchestral instruments, and were no longer used to give any suggestion of the military band, as they had been in Beethoven's *Ninth* and *Battle* Symphonies.

With the increase in world-wide trade, instruments from all over the world have flooded in to our culture, and have been used by our composers. Often this has been in the studios, where new sounds are always eagerly sought after, whether to accompany a film set in exotic places, or merely to catch your ear so that you are more likely to buy a new soap powder. Film-music composers will sometimes come to a collector like me to see what we have and what they can use in their new film. Jerry Goldsmith asked me to produce a chromatic scale of conch trumpets which, when mixed with serpent and didjeridu, became the voice of *The Alien*. Maurice Jarre used many of my odds and ends in his *Man Who Would be King* and *Jesus of Nazareth*. For both they were there for local colour, imitating the sounds of the Levant and of the mountains north of India.

These are legitimate uses for musical and atmospheric effect, but there has been a tendency for composers who run out of new musical ideas to fill the gaps with new sounds instead. This, I feel, is a pity for it debases both the music and these sounds. It also leads to many musical problems for those with sensitive ears, for many of these instruments are tuned to their local scales, and these clash with our own tunings. This we shall come back to when we are going through the percussion, for as we have already

observed in passing, many of these instruments are percussion instruments, or at least are sufficiently exotic that it is the percussion players who are expected to handle them — not the sort of thing that the ladies and gentlemen of the string or wind sections should be exposed to!

Whether the modern movement of population which has resulted in, for example, the inclusion of the Indian sitar in the pop group or the popularity of the Greek bouzouki in various types of light music, to take just two examples, can properly be laid at the door of the Industrial Revolution or not, is a matter for debate. I think that it can, for much of this is due to the package holiday, to the ability of people to travel widely, and this has only come about as a result of the high wages that can be earned in industry. If we were still an agricultural nation, as we were before the Industrial Revolution began, we would still regard Abingdon as a long journey, and Wiltshire or Warwickshire as foreign countries. Our travel, as well as that of our music and our instruments, has in the last hundred years multiplied as much as it has done simply because of the effects of industry on our lives. My parents saw the first motor cars in England, and today we fly in jets.

5 String Instruments

We've already discussed the changes to the bows with which string instruments are played, and these, as we saw, were mainly a matter of the availability of new materials, though as we shall see today, it was other influences which demanded the changes of shape. Today we are concerned with the instruments, and here new materials had practically no effect at all. What led to the changes in the instruments was, to some extent, changes in musical styles, but chiefly the effects of the social changes due to the Industrial Revolution, principally those which we encountered in the first of these sessions.

The sound of the violin in the mid-eighteenth century was quite different from what it is today: the bridge was lower, the neck was shorter, the string tension was lower; the bow was softer with a narrower ribbon of hair, an outward arch or an almost straight stick, and a low point; the strings were all of gut, though the G-string was sometimes covered from the 1660s (the first reference in English is in Playford in 1664, and in French in Perrault, in 1680), but one suspects that common use of a covered G was probably later still.

This sound remained almost throughout the eighteenth century. Changes to the instrument started after the middle of the century, with the increase in range that players were achieving and composers were demanding. It looks, from surviving music, very much as though this started with the 'cello, perhaps because

it is so much easier to go high on the fingerboard of an instrument held downwards than with one held on the shoulder. Boccherini, for example, goes higher in relation to the open-string notes, than the violin composers of his period. Whichever instrument of the violin family that it was, it is fairly obvious what had to happen — the fingerboard had to be lengthened so that the player would not be trying to stop the strings in mid-air. This is not something that affected the basic sound of the instrument; fingerboards only last a few years anyway, for the pressure of the fingers on the strings wears grooves in the fingerboard so that it either has to be planed down, or more practically, swapped for a new one.

In the latter part of the eighteenth century, the bow began to change, changes which we mentioned last week and which can be seen in David Boyden's article in *Early Music* of April 1980; it is important to read also Julian Clark's response to that article in that same periodical in October 1980.

The reason for these changes in the shape of the bow was the desire for more sound from the string instruments. Society had changed because the Industrial Revolution led, as we have said several times before and will probably say again, to the rise of a middle class of wealthy non-aristocrats who wanted the pleasure of going to concerts and listening to music, and also to the rise of the new towns, with a larger potential audience who were in a position to pay for it. This led to the widespread construction of concert halls all over Europe and to the professional orchestra

playing for a paying public, in contrast to the old system of a private orchestra playing to the Prince and his invited audience.

Once there was a paying audience, all its members felt entitled to hear the music, and they had to hear it in a larger hall than the Prince's salon because, unless the hall was larger, it could not hold a large enough audience to pay for the orchestra. Once the hall was larger, unless the orchestra was larger than the size which had played at Esterházy or wherever, it could not be heard in the larger hall. This is a vicious circle that is still with us today, and this is the reason why there are no big concerts in Oxford.

As a result, the orchestras increased in size. In Haydn's early symphonies, he used two oboes and two horns, plus one or two bassoons, which were normally unspecified but which may be assumed to have been there. In his middle period Haydn added a flute, he started to specify the two bassoons, and he added two trumpets and timpani if he was writing in the right keys, one of those for which trumpets were available. In his later period, Haydn added the second flute and two clarinets.

The violins and other strings had to be louder to balance these added wind and to be heard at all in these larger halls. This they achieved in three main ways:

1) players changed to the Stradivarius model, where the Amati and Stainer models had previously been the more popular;

2) the standard pitch went up, increasing the string tension and thus providing a louder sound;

3) string tension was increased further by using a higher bridge, which better suited the new bow.

The Amati model and the Stainer, with their highly arched body, as you can see here in the Bate and in the Ashmolean Museum, produced what David Boyden has described as a flute-like sound, which was the ideal of the Baroque violinist. The Stradivarius model, with its lower arching and flatter body, was the less popular of the two before the concert hall developed, but it then came into its own, for it was more powerful and its sound, which Boyden describes as more oboe-like, cuts through the sound of the wind instruments more successfully, even if it does not blend so well. Interestingly, the Stainer model seems to have continued to be popular in Britain; there are many Stainer copies by English makers rather later than by Germans and other Italians.

The pitch in London around 1700, when Bressan made his recorders such as those we have in the Bate Collection, had been about A=409, about three-quarters of a tone below modern pitch. By 1750, in London it was around A=415, a semitone below modern pitch; by 1800 it was A=437 or above, and by 1850 it was A=454, the Old Philharmonic or High Pitch which remained the standard here, though the French had brought theirs down, until Dr. Cathcart bribed Henry Wood to bring it down by insisting on A=439 at the Proms. He was a doctor who was concerned at the strain on singers' voices, and he promised to find backing for the Proms on condition that Wood promised to use only the low French pitch. The French pitch, or diapason normal, is ex-

pressed as A=435, and English low pitch or New Philharmonic, is expressed as A=439, but they were intended to be the same; there is a different coefficient of temperature in the two standards, which explains the four Hertz difference. Obviously if you screw the strings up tighter to get a higher pitch, you increase their tension.

Because the hair of the new Tourte model bow was tauter than that of the older bow, a rather more highly arched bridge was found advantageous, and since this stretched the strings a bit more, it again added to their tension.

The result of these changes to the string tension was that the violins came apart. The old pattern was put together simply by driving two or three large iron nails through the neck block inside the body into the neck. The bridge was supported by a girder, called the bass bar, running along inside the belly under the bass foot of the bridge, and by a pillar, called the sound post, standing under the treble foot, and holding the belly and the back apart. These were all that prevented the pressure of the strings driving the feet of the bridge down through the belly. None of these were sufficient to withstand these pressures.

So the instruments had to be rebuilt. The neck and the neck block were now made from one piece of wood, and the ribs were morticed into the side of the block, instead of the block being one piece of wood inside the ribs, and the neck being another piece outside, the two nailed together through the ribs. At the same time, the neck was lengthened by about a centimetre, which led

to greater string tension still because if you have a longer string and screw it up to the same pitch, the tension must be higher. In order to withstand the strain, the neck was canted back, just as one leans back on the rope in a tug-of-war. Because the neck was canted back, the wedge between the neck and the fingerboard was abolished. There was enough slope on the neck, now, for the fingerboard to follow the plane of the strings without needing a wedge. There were internal changes, too. The bass bar was greatly lengthened and thickened, and the soundpost was also thickened to almost twice the diameter of the old one. The miracle of all this is that after these changes, the instruments still sounded so well; there wasn't much left of the original Strad. Usually the new neck was grafted on to the old scroll and peg box, simply because nobody wanted to throw away so beautiful a bit of carving, and of course the old box was still there, belly, back, and ribs, but everything else was new.

A new problem arose in playing the instrument. With the old wedge fingerboard, as one shifted position downwards, the fingers and thumb came together as the neck got thinner, as it were squeezing the instrument into the neck. This was Menuhin's comment when we gave him the opportunity to play a Baroque violin for the first time — that there was no feeling of insecurity when shifting down, because of this squeeze. Now that the back of the neck and the fingerboard were parallel, this feeling of security vanished, and players did indeed feel that they might be going to

drop the instrument. The solution was first put in print by Spohr in about 1820 — a chin rest.

Now, none of this happened immediately; it was not a case of "Next Tuesday we will modern be." The process started somewhere around 1780, and it took to 1820 or so. Thus throughout Beethoven's lifetime, the string instruments were gradually changing, with more and more members of the orchestra getting up to date, and fewer and fewer playing on the older pattern instruments, and thus gradually the string section sounding louder and clearer, while, as we shall see, the wind section was also getting louder in rivalry. This is a never-ending problem; even today, the strings will say "Wind, you're drowning us."

It was this process which brought the members of the violin family from the Baroque state, in which they were made by most of the greatest masters, into the modern state in which we know them today. None of the technology involved owed anything to the Industrial Revolution — even the materials remained the same, unlike the bows, where widening trade contacts had made new woods available. It was, simply, the social conditions of concert giving that made these changes necessary. It is these same conditions that make it difficult for some people to come to terms with the growing movement towards authentic performance. When you put an early music orchestra into a normal concert hall, the sound seems thinner, not surprisingly, than that produced by the Royal Philhamonic, and some people dislike this. One of our advantages, here in Oxford, is that our halls are all de-

signed for Baroque music, and thus we do not have that problem — the problem that we do have, is that we cannot have the Royal Phil here.

When you are looking at string instruments, there are three obvious external signs which allow you to tell the difference between those in original state and those in modern state: the length of the fingerboard, which is not wholly reliable, for many were, and are, transitional; the angle of the neck and the presence or absence of a wedge; and the use of a chin rest.

Once these changes were established, in the first quarter of the nineteenth century, there has been little further change except to the string materials. Gut, covered for the lower strings, remained the normal material for about another century, until the early years of the twentieth century, when the steel E string arrived, but gut Es were still to be heard up to 1939. Kreisler, for example, never used a steel E; it might be more reliable and less likely to break; it might even be louder, but the whining sound was not tolerable. All-steel arrived after the war; as financial restrictions were eased in the 1950s, supplies came over from America. Today, very few people use anything else, despite the inferior tone quality. Steel strings are far more reliable, and they produce a louder, if nastier, sound, and in modern concert conditions, and even more in modern recording conditions, absolute reliability is essential. The sound of a snapping string could cost several thousand pounds if it ruined a take and meant that a new session was needed.

Silk had been tried as a string material in the latter part of the nineteenth century under the name of Acribelles. It was never very popular with professional players because the tone was not as good as gut, though amateurs used it, for silk strings lasted rather longer than gut. It was widely used in the tropics, by professionals as well as by amateurs, because it was much less likely to rot with the sweat of the fingers. Remember that this was a period of Empire; many people were playing the violin in India and Africa and other hot climates, and in those days, before the aeroplane was invented, all travel was by sea. Every liner had an orchestra and a dance band, and many of the sea routes went through the tropics.

There are some entertaining books by Joseph Wechsberg on his days as a ship's musician in the Mediterranean and the Red Sea, describing just what it was like to play in such conditions.

There was one basic change of playing technique in the latter part of the last century and the early part of this one. This was the introduction of the incessant wide vibrato. It is always said that it was Joachim, Brahms's friend, who introduced it, but there are early recordings of Joachim, and from them it sounds as though his vibrato was normally very slight, only enough to keep the tone alive, with a wider vibrato used, as it always had been, as an ornament in appropriate places. One purpose of the modern vibrato is that it covers faults of intonation; if everybody's fingers are rocking over a range of a quartertone or so, nobody can be accused of playing out of tune. Maybe that's why singers do it too, though I

suspect that the really distressing sound produced by people like Janet Baker and Maria Callas is due to poor teaching, leading to bad breath control.

The other bowed strings, of course, followed the violins through all these changes. The viola has additional problems of size, once it has to be supported by the chin; the extra length of the body produces too much turning motion for muscles of the neck to be able to support it. This led to the introduction of the Tertis model which was shorter, though thicker from belly to back, and thus easier to support. The problem is that in making it shorter and yet keeping a sufficient air-body inside the box to resonate the lower-pitched strings, the box really became too thick, and the sound rather too tubby, so that it seems already to be going out of fashion again.

We know surprisingly little of the history of the 'cello; all the books concentrate on the violin. For example, when was the tail-spike invented? It seems to have been available from the eighteenth century, and yet it was not universally used until late in the nineteenth, or even early in the twentieth. Some eighteenth-century players used a small stool to rest the instrument on; others held it between the calves like a bass viol, and these practices seem to have continued until very recently as far as one can judge from pictures. An advantage of the spike is that the sound travels down it to the floor, which, when it is wooden, adds something of resonance, but when it is of stone, this resonance is missing, which must be disconcerting to some extent, and of course, un-

less one uses an anchor of some sort, it is liable to slip. As I said earlier, it looks from the musical evidence as though high positions were used earlier on the 'cello than on the violin, so that one wonders whether the 'cello led the rest of the violin family into the longer fingerboard and some others of these changes. A lot more research is needed here.

It is said to have been Casals who invented the modern position, that earlier players held the neck somewhat to the side, whereas Casals put the scroll right by his ear so that his arm went straight down the fingerboard. This is not wholly borne out by looking at illustrations, and here again there is scope for further research. It was certainly Rostropovitch and others of his generation who introduced a newer position, using a bent tail-spike which leads to a flatter position of the instrument.

If we know little about the 'cello, we seem to know even less about the bass. Through much of the nineteenth century, many basses had only three strings, with the lowest tuned to the G or A below the 'cello C. Four strings were general in the latter part of the nineteenth century, with the lowest string tuned to E. Mahler demanded that at least some basses should have five strings, and these, with the lowest string tuned to the C an octave below the cello, have been available in any large orchestra ever since, or, as a compromise, four-string instruments with an extension to the fourth string, which covers the same range with less good tone. Despite all this, which is the 'accepted' history of the bass, Praetorius shows a double bass with five strings in 1619. Unfortunately,

his descriptions are unclear, and while this looks like a double bass, he seems uncertain whether it is a great bass viol, going down to low D, or a great bass member of the violin family going down to C. He also lists a Groß Quint-Baß with five strings, tuned as the normal bass in his terminology, the 'cello in ours, with a low fifth string going down to F. What happened in between, we have very little idea, nor have we any idea how many strings basses available to any composer may have had until we get to Berlioz, who says that some have three and others have four. The fact that Beethoven, who seems to have been the first to separate bass and 'cello lines, takes the bass down to E, suggests that at least some of his basses must have had four strings.

Bass bows such as the German Simandl, the Italian Dragonetti, and the French Bottesini patterns, which can be seen upstairs in the Bate Collection, differed geographically as well as typologically. The Dragonetti, which persisted in England into the twentieth century, was fairly general before either the German bow or the French were adopted in the latter part of the nineteenth century. Most players in Britain now use the Bottesini bow, but some use the German Simandl bow, which has a slightly better tone quality, especially for chamber orchestras.

One of the features of the Industrial Revolution was a growing interest in physics and, with relevance to us, of acoustics. There seemed to many acousticians to be no real reason why the violin should be made in this funny and elaborate shape, and many of them experimented with the instrument, the famous of whom

were Savart and Chanot models. Neither were very successful. It seems probable that their failure was likely to have been due as much to a combination of poor quality makers and musicians' conservatism as to any inherent problems of sound. More recent developments have been in a quite different direction, by electronic amplification.

Such acoustical improvement met with more success with the guitar. In the seventeenth and eighteenth centuries, the body had been quite narrow, with five double-strung courses. In the early nineteenth century, the body was rather larger, with six single strings, and the body was greatly enlarged on the best acoustical principles by Torres in Spain in the middle of that century.

There were various funnies. Staufer invented a bowed guitar, the arpeggione, which merits revival if only for the proper performance of one of Schubert's most beautiful sonatas. Even odder things happened to plucked guitars; some followed the fashion of making things Greek, which was one of the odder aspects of the French Empire style, with guitars made to look like lyres. Others added open bass strings like a harp for accompaniment. Another form of guitar was built on a body rather like the old Renaissance cittern. This was the English Guittar which became so fashionable with ladies (for whom Smith designed the miniature piano keyboard to strike the keys, so that they wouldn't break their fingernails by plucking the strings) that people stopped buying harpsichords. The harpsichord maker Kirckmann dealt with that by buying a couple of dozen guittars and giving them to what

was politely called the Ladies of the Town, i.e. the local call-girls. Here again trade had an influence, for we see the same instrument in Portugal. Whether it was carried thither with the port trade, or whether perhaps it came thence with the port, we don't know. It can't have been from Spain with sherry, for this type of instrument is not used in Spain; the Portuguese call this the guitarra; the Spanish guitar they call viola, clearly a derivative of the older Spanish name, vihuela.

Certainly the Baroque harp came from Italy. This was the Triple Harp, which remained the normal instrument into the eighteenth century, and was, and still is, the only fully chromatic harp, with the diatonic strings in the two outer rows and the chromatic ones in the middle row. It survived in Wales as the Welsh harp, and although it almost became extinct in this century, it survived by the skin of its teeth and is now being played there again. It is an expensive instrument to maintain because of the cost of the strings, and a cheaper instrument, the hook harp was introduced in the late seventeenth century. Not all the strings had a hook, which could be turned to stop the string a semitone shorter, and so it was not fully chromatic. Also time was needed to take a hand from the strings to turn the hooks. However, it was much cheaper because it had only one rank of strings.

With the developments of technology and mechanical knowledge, there were attempts to use pedals to move the hooks. The first came in the middle of the eighteenth century with Nadermann's crochets which pulled the strings into the neck. Each

string had its own pedal so that pressing, for example, the D pedal operated the crochets on all the D strings, shortening their length, and thus raising the pitch to D♯. This was followed in the late eighteenth century by an improved model by Cousineau which had béquilles which turned to grip the string. Finally, in the early nineteenth century, Sébastien Erard devised his fourchettes, a wheel with two pins which turns to grip the string. In 1810 Erard patented the double harp, which is tuned in C♭. When the pedal is depressed to the first notch, the upper fourchette turns and the string produces C♮. When the pedal is put down to the second notch, the lower fourchette turns and the string sounds the C♯. Not everyone liked the system, of course; some harpists in complex music feel that they are pedalling like a competitor in the Tour de France, and so Henri Pape devised a new form of chromatic double harp in 1845, with two ranks of strings crossing each other in an X, and no mechanism. Lyon & Healy (who followed Pape in making these instruments) commissioned Debussy to write his *Danses Sacrées et Profanes* to show how good the instrument was. Erard, not to be outdone, commissioned Ravel to write his *Introduction & Allegro*. Erard won; his instrument was more efficient, and also it was cheaper because it had only one rank of strings, and it is, in all essentials, the harp which is still used today.

There were, and still are, many other odds and ends among the strings, such as mandolins and banjos, both of which were widely used by expatriate traders in the outposts of empire be-

fore the invention of wireless and gramophone made it less urgent to make your own music if you wanted any at all. Today, we have gone even further with technology, with electric guitars and all such things, but these, I think, are well enough known not to need detailed explanation. As with all instruments, coverage in The New Grove Dictionary of Musical Instruments is reasonably thorough, and if you want to know more, find a good pop musician!

6 The Flute

The characteristic use of wind instruments in the Baroque period was often in threes; three oboes, three trumpets, and so on, though there are also plenty of examples of pairs. In the Classical period that followed, with one exception it was the pairs that dominated, and this persisted up until Berlioz, Mahler and Wagner, and indeed is still common today. The exception was the flute. In the earlier Classical period, roughly up to Beethoven, it was usual to have pairs of oboes, horns, and bassoons, plus, if the orchestra were sufficiently up-to-date, a pair of clarinets, and for works in the right keys, a point that we'll come back to when we reach the brass instruments, a pair of trumpets and drums, but only one flute.

Why was the flute an exception? It seems to have been a matter of tuning. For one thing, the one-key flute was not as good at cross-fingering as the oboe and bassoon, nor even the clarinet, so that players had to roll the embouchure against their lip to reduce its area and flatten the pitch, which muffles the tone a bit, or roll it away from the lip to enlarge its area and so sharpen the pitch, which brightens the tone a bit. The result was an uneven tone quality and inevitable variation of volume if one wished to play in tune. Flautists still do this today to control intonation, and thus there can still be problems about producing an equal tone quality, but such problems are nothing like as extreme today as they were in the eighteenth century, when every F♮ or B♭ was in-

evitably more muffled than the neighbouring notes. Reed players have less of a problem here, for they can alter the pressure on the reed very slightly to achieve the same effect, and this does not affect either the tone quality nor the volume.

For another thing, the tone of the flute is very weak in harmonic overtones; it is the nearest thing we have in the orchestra to a pure sine wave, without any overtones at all. As a result, when two flutes are just out of tune with each other, one can hear very clearly, much more clearly than with other instruments, the beats between the two. With other instruments, these beats are disguised or covered by the overtones, which may or may not also be beating, but which produce a much richer sound.

It was not until the various improvements which we will come to, many of which were due to the facilities made available by the Industrial Revolution, that players were able to overcome some of these problems and it became practicable to use flutes in pairs like any other instrument.

The Renaissance flute, a straight, wooden cylinder with six fingerholes, was improved for acoustical reasons by the makers at the French court of Louis XIV, led by members of the Hotteterre family, around 1660-1670. They made the instrument in three joints, with a cylindrical head joint, a tapering body, widest at the head end, and a separate foot, with a single key on the foot joint. The reason for making it in separate joints was so that it could be reamed more accurately, for with shorter reamers there is less whip than when one has one long reamer that has to reach

the whole way down the bore. A reamer is a tool which is shaped exactly to match the desired bore (we have examples on display in the Bate Collection); one starts by drilling a cylindrical pilot bore down the piece of wood, and one then uses the reamer to turn this into precisely the shape desired.

The purpose of the tapering bore was to get the overblown upper notes into tune and to extend the range at the top. The purpose of the key was to avoid half covering the lowest hole when one wanted to play E♭ or D♯ — the lowest note of the flute at this period was D. Opening the holes in sequence gives one a scale of D major, and as we've already seen, one could get F♮ and other chromatic notes by cross-fingering, just as one does on the recorder. The only note that can't be cross-fingered is the semitone above the lowest note, for there is nothing below the lowest fingerhole to cross-finger with, and the only way to get that note on a Renaissance flute is to half-cover the hole. This isn't so easy with an instrument stuck out sideways at arm's length as it is on the recorder, and anyway music was becoming more chromatic all the time, so that this note was more often required than it had been in, for example, Monteverdi's music. Hence the key which not only made that operation easy, but also could be used as a vent to tune some of the upper notes. Johann Joachim Quantz, the flute teacher of Frederick the Great, and the author of the most important book on playing the instrument, was fussier than most, and he insisted that his flutes, and Frederick's, should have two keys instead of one, one for E♭ and the other for D♯. These were

quite different notes in that period, about a quarter-tone apart, and also, since the two holes are different in diameter, one can be better than the other as a vent for certain higher notes.

The result of all these modifications to the instrument was a total change in tone quality, tuning, range, and volume, and the creation of the baroque flute. We should not be referring to "flute" in this context; "flute" at this period always meant the recorder. What we call the flute today was then called traversa / flauto traverso / flûte d'Allemagne / German flute, etc. — it was always adjectivally qualified.

In around 1720 or maybe a bit later, the body was cut in half, so that the four-joint flute became the late Baroque and the Classical instrument. The advantages of this were two-fold: shorter reamers still could be used, leading to more accurate tuning, and players could use corps de rechange, a set of upper-body joints, each a slightly different length. In those days there was no standard pitch, and while it is possible to draw a joint slightly out of its socket to produce a different pitch, when one does so, because the wooden tenons are quite thick, it creates cavities in the bore which do horrible things to the tuning. It was much better simply to change to a joint of different length. In addition, Quantz suggested that in a quiet movement one should use a shorter joint, which sharpens the pitch, and then blow quietly and gently, which brings the pitch down again. Similarly, in a loud movement, one uses a longer joint, which flattens the pitch, and belt it out which sharpens it back to where it should be.

These changes still left players cross-fingering the chromatic notes and, as a result, producing a somewhat quiet and muffled sound. A few players did experiment, even at the earlier date of the Hotteterre style instrument, with extra holes for F♮ and G♯ or A♭, but the majority preferred the veiled sound. By about the 1770s, with the introduction of the concert halls that we have mentioned in almost every session so far, the larger orchestras, and so forth, this veiled sound became unacceptable. As a result, extra keys were added, creating the four-key flute, with a key for F♮, a key for G♯ or A♭, and a key for B♭, plus of course the existing E♭ / D♯ key. The adoption of these mechanical keys was hastened by the wider choice of musical keys for writing music and the increased chromaticism within that music, as can be heard, for example, in Haydn's symphonies, particularly those of his Sturm und Drang period. This may have happened as early as 1750 / 1760. With these keys, the chromatic notes became almost as strong as the finger-hole notes; not quite as strong, because the holes under the keys were, for practical reasons, usually rather smaller than the fingerholes.

Slightly later, certainly by the 1780s, the range was extended first to C♯, and then to middle C. This had been tried earlier, as we know because it was condemned by Quantz as ruining the tone quality, but it is clear that some composers found this extension of the range useful. Mozart, for example, goes down to middle C in some of his solo flute music. It seems also possible that a reason for the adoption of this extension was to widen the break.

A problem with any wind instrument comes when one is playing round the area where one changes from all fingers off to all fingers on again; trills or rapid figuration in this area is always difficult. Extending the flute means that there are two notes which can be played either at the top of one register or at the bottom of the other, and this can sometimes be a help.

There were other improvements at this period. Richard Potter, in 1785, patented his pewter plugs for the keys, the screw cork, the tuning slide, and the register. The pewter plugs were especially useful on the extended foot joint, for whereas the old flat leather pad on the keys bedded down on closed holes, much as one can see the shape of a hole on one's finger after pressing it on the hole, they had no chance to bed down on the C♯ and C keys because these were open-standing keys and they were only closed on the holes when those notes were required. The pewter plugs needed no pressure to bed down, and some makers went on using them right to the end of the nineteenth century. The tuning slide, which is two thin brass tubes sliding telescopically over each other, avoids cavities in the bore, and the invention of this of course was directly due to the rising level of technology available at this period, made possible by the more accurate manufacture of metal tubing. The screw cork and the register spread the tuning movement from the upper body over the whole length of the instrument, for it allowed the player to move the cork a little way away from the embouchure, and to lengthen the bottom

end of the foot joint with another short tuning slide at that point, the register.

Two new keys were added, the upper C♮, to produce the last chromatic note, and the long F♮, which allowed an alternative fingering for that commonest of naturals. With these keys, the eight-key flute was complete, and this remained the standard instrument until well into the nineteenth century, and indeed is still in makers' catalogues today. It is still the preferred instrument with Irish folk musicians, for example, and it is still often used in flute bands.

The flute was still a comparatively quiet instrument, and certainly it had more difficulty in the lower register in cutting through an orchestra of the new larger size than an oboe did, with its more piercing sound and richer harmonic spectrum. Some players sought to obtain more sound, the most famous of whom was Charles Nicholson in London. Nicholson, in about 1825, redesigned his flute, very considerably enlarging some of the fingerholes. The result was not universally popular. Some of his contemporaries said, roughly, that if they wanted a trumpet instead of a flute, they'd write for one; similar remarks have been made more recently about Jimmy Galway. Fellow players who tried Nicholson's model complained about the poor tuning; if you enlarge the diameter of the fingerholes, you change the pitch produced. Nicholson was powerful enough — he was a very large man — to lip these notes into tune, but some of his colleagues

were not. Nevertheless, a number of other mid- to late-nineteenth century makers produced flutes with Nicholson holes.

Probably the most far-reaching result of Nicholson's Improvement was the envy that the volume of sound he produced aroused in a young German flautist who was visiting London. This was Theobald Boehm, who determined to produce an instrument as loud as Nicholson's but without his problems of tuning. His first model, produced in 1832, retained the tapering bore but moved some of the holes to more rational positions so that their larger size did not upset the tuning. A wider hole produces a sharper pitch, but a hole further down the bore from the embouchure, the hole into which one blows, produces a flatter pitch. Combine the two changes, and you maintain the status quo.

A much more radical change was to the mechanism of the keys. Boehm was also trained as a goldsmith, accustomed to delicate work with metals, and instead of simple levers with a central axle, the 1832-system flute has long rod-axles, held between pivots at each end, with the key and the touch at right angles to the levers. These were far more precise in their movement than the long levers and far less prone to whip and lost motion. Unfortunately, the long axles meant the end of boxwood as a material. Boxwood produces a very sweet sound, but it expands and contracts so much with changes in humidity that Cornelius Ward described it as more suited to a hygrometer than to a musical instrument. The articulation of the Boehm axles was so precise that even slight changes in the length of the wood could mean that the

axles either jammed or failed to articulate properly. However, as we have already seen, the African and South American trade was opening up, and new woods, which were less affected in this way, were becoming available in large quantities. Thus cocus, rosewood, African blackwood, all became popular for flutes from this time on.

This mechanism of the 1832 flute became the basis of all modern woodwind mechanisms. There were, of course, improvements by various makers. Buffet, for example, who was Boehm's French agent, invented the needle springs instead of the old flat springs which had been in use. He also devised the clutch which allowed the outer sleeve of an axle to move without moving a key, which could itself be moved by the rod axle within the sleeve. Both these devices were adopted by Boehm himself. As we shall see, Buffet applied all these devices to his pattern of clarinet which, rather unfairly, is known by Boehm's name rather than his own.

For the next fifteen or so years, Boehm was fully occupied in restructuring the Bavarian iron trade, but he then returned to the problems of the flute, which he had presumably been thinking about in the meanwhile. His 1847 system was a radical reconstruction. The whole instrument was now acoustically rational, with a cylindrical body, often of metal; a parabolic head; fingerholes as large as possible relative to bore diameter; all the holes in their correct acoustical positions; and all the holes open. The reason for the parabolic head, which tapers from the body on a

slight curve, so that the cork is at the narrowest point, is that there must be some conicity in a flute if the overblown notes are to be in tune. The reason for the preference for metal as a material is that it is affected even less than the new woods by changes in humidity; Boehm did make wooden flutes on this system often enough, but he preferred silver. The fingerholes were as large as possible so that they would vent their notes as strongly as possible and so that the tone of a note speaking through a fingerhole would be as nearly equivalent as possible to that speaking from the open end of the tube. The reason for all the holes being open was that one moves a key from its position of rest against a spring. One needs a more powerful spring to hold a note closed so it won't leak than one does to hold it open, and open it again after closing it; thus closing an open hole needs less effort from the player's finger than opening a closed hole. Hence an open-hole flute takes less effort to play, especially in fast music.

The result of all this was that the holes were now too far apart for the fingers to stretch; they were too wide for the fingers to cover them against leakage; and there were now more holes than a player has fingers. Therefore all the holes had to be covered by plates, and a new mechanism had to be invented to operate them, which resulted in a totally new fingering system. Not surprisingly, this proved unpopular with many players. Imagine what would happen if someone mixed up all the keys of a piano or a typewriter; it would make either playing or writing very difficult until one got used to the new arrangement. Players, who often have

to play very fast music, often at sight, and always under conditions of stress (a polite synonym for stage fright), are particularly resistant to such changes, and this is not very surprising.

One result of this resistance was Carte's 1851 system, which is marked Boehm's Parabola and Carte's system. The system is basically that of the old 8-key flute, so that players could use a flute which looked like a Boehm, that sounded like a Boehm, but which was fingered like the old flute they were used to. The Boehm system was eventually adopted by most players, as we all know, though it was often adapted in various ways. One of the best compromises was Carte's 1867 system, which was used here well into the twentieth century. The strongest resistance, oddly enough, was in Boehm's own country; the Reform flute, devised by Schwedler and Kruspe as an elaborated eight-key flute, was widely used in Germany, again well into the twentieth century, though nowadays most players use the normal Boehm system.

There was resistance from amateurs everywhere. One of the many results of the new mobility of society was the very marked increase among amateur players, as we have already noted, and the flute, being a fairly easy instrument to play, was one of the most popular in such circles. Composers such as James Hook churned out reams of music for the amateur flautist. All sorts of other music was arranged for flutes, Haydn's symphonies, 'The Hallelujah Chorus' for two flutes and piano, and so on. The amateur resistance came partly because of the complexities of the new fingering, and partly because few amateurs were playing mu-

sic complicated enough really to need it. Pratten, for example, produced one Perfected system after another, all slightly different, but all basically eight-key flutes on a cylindrical bore. These were especially popular in the flute bands. These were a popular movement among amateurs, and still exist in this form in Scotland and Ireland. There were also many boys' bands using flutes. Above all there were the military bands; the brass instruments and other woodwind were used in camp, but on campaign, where bands were still being used up to the First World War, they were flute bands, the fifes and the drums. Similar to them were the other uniformed bands, such as the police and so forth.

Abel Siccama was another inventor; he retained the old tapering bore but he moved two of the fingerholes to better positions and devised a third order lever to cover them; the fingers fall where the holes used to be, but the lever enables them to control a hole out of their reach. Giorgi was more extreme; he approved of the cylindrical bore, but thought that all these keys were the root of the problem, so he removed them all. The resulting instrument, with eleven fingerholes (one, plus the open end, for each note of the chromatic scale) was so awkward to hold sideways that he provided a T-head so that it could be held downwards. Even then, the hole for the side of the forefinger was so awkward that a key had to be provided; this was followed by others, and I've seen Giorgi flutes with at least six keys; we have a 1-key and a 3-key in the Bate Collection.

Today even most amateurs use the Boehm flute if they are playing the transverse flute at all, but there are players who never really come to terms with the flute's embouchure. From quite early in the nineteenth century, when the amateur flute movement was at its peak, gadgets have been made for them. Wheatstone, the great acoustician who also invented the concertina and the mouthorgan, made a clip-on embouchure. A number of makers produced flute-flageolets, flutes which would look like a transverse flute but which were blown like a whistle. One could either buy a flute-flageolet or an ordinary flute with an alternative flageolet head. We have examples of both in the Bate Collection.

Players who were even more amateur than that, or who simply preferred the sound, played the true flageolet. In its simplest form, the English flageolet is a duct flute with six fingerholes. It, or something very like it, has existed since prehistoric times, with from four to six fingerholes, and it still exists today as the tin whistle; in fact Professor J.V.S.Megaw used the term penny whistle as a good blanket term for all the archaeological examples. As sometimes happens with amateur instruments, it became progressively elaborated in the late eighteenth and early nineteenth centuries into a double and even a triple flageolet, the double with a flageolet head holding two parallel bodies with the fingerholes; the triple flaeolet added a third tube at the back with holes for the thumbs. Such instruments were no doubt fun, but unnecessarily complicated to play, something that no professional would put up with for a moment.

A few amateur transverse flute payers believed in complexity, too. James Mathews was the most outstanding of these. He was a man who believed that a problem was best overcome with a new device, rather than with practice. He had a series of flutes made, all with rather pretentious names. Barbiton is now in America; Chrysostom is here, and so is his final model Chrysostonides, complete with all the instructions for the maker. But Mathews was an exception.

What the professionals did use was the French flageolet, which was known from at least the seventeenth century onwards; Pepys refers to one in his diary. This had four fingerholes and two thumb holes. It also gradually became more complex, but only for the sake of greater facility. Extra keys were added for the chromatic notes, and eventually the full 1831 conical-Boehm key system was added. This was the Quadrille Flageolet which was so popular at the early Promenade Concerts.

We have ignored the larger and the smaller flutes. The transverse orchestral models followed the full size instrument in mechanism. They had to, because the player puts one down and picks up the other. The only important difference is that the piccolo practically never acquired the C-foot, and its lowest note remains D.

Band flutes came in a variety of sizes, from band piccolos in E♭ and smaller, through the B♭ flute, which was earlier called the fife, the F flute, down through the baritone B♭ to the bass. Terminology is complex. Some late eighteenth and early nine-

teenth century F flutes are marked 3; this indicated that they were thought of as small size orchestral flutes, the third flute, a minor third higher than the standard flute, and there is a small repertoire for them. Equally, the B♭ baritone (or tenor; both terms get used) is often confused with the earlier flûte d'amour whose lowest note was also usually B♭. Orchestral bass flutes also go back to the eighteenth century. Diderot & D'Alembert show one in their Encyclopédie. It has always been a difficult instrument to hold out sideways, which is why the eighteenth-century one had the head bent back on itself, especially if the bore is wide enough to produce a really good tone. This is why Albisi invented a wide-bore model which is held vertically.

English terminology for the band flutes is even more complex because the name refers to the note produced by covering the six fingerholes. Germans and Americans call them by the note that would be produced by the C-foot, which is rarely provided, so that the B♭ flute is called the A♭, the F the E♭, and so on. This not logical, to call an instrument by the pitch that it would produce if it had two extra keys and an extension that are not there.

But then, as we all know, little to do with music, and even less to do with instruments, is ever logical. The Logical Bassoon is one of the instruments that we shall encounter when this series resumes next term.

7 Single Reeds

The various social changes which we have detailed virtually coincide with the adoption of the second new instrument of the eighteenth century. The first, the piano we have already discussed; this second one was the clarinet.

It was not wholly new. It grew out of the chalumeau just as the oboe grew out of the shawm, as we shall see next week, but whereas the baroque recorder, traverso, oboe, and bassoon were all creations of the late seventeenth century, the clarinet was a creation of the eighteenth and, as we shall see, was not generally adopted until well into the last quarter of that century. But first some background.

Up to the middle of the seventeenth century, the chalumeau was a term for either an indeterminate reed instrument or a folk instrument, as can be seen in Mersenne's treatise *Harmonie Universelle* of 1636, with a zummara-type reed like that of many folk instruments. Before 1700 it became a short, clarinet-like instrument (i.e. with a separate mouthpiece and a tied-on reed), about descant recorder length or shorter, probably with 2 keys. This instrument by Stuehnwal of Munich, who is an otherwise unknown maker, is the only example known of this type of chalumeau. In general, information is scanty and chalumeaux are few. We know, from one rather later reference, that "J. C. Denner improved the chalumeau". What we do not know is whether those by Denner that we have are pre- or post- the "improvement"; the Stuehn-

wal looks to be pre-, but others, more like the Mersenne, may have still been in use, so that the Stuehnwal also may be post-. We know that the chalumeau was written for by composers such as Telemann and Molter and others, and we know from this that there was a full family of chalumeaux, from treble down to bass.

We know, because some survive, that J. C. Denner produced treble recorder size instruments, very differently shaped from the stubby Stuehnwal instrument. What we don't know is whether these are ordinary alto chalumeaux, or whether these are his improved chalumeau, or even whether they are the first version of the clarinet, which he is said to have invented. Colin Lawson suggests that they are alto chalumeaux, and I think that they are likely to be Denner's improved model.

They share a basic problem with the clarinet: they are reed-blown cylindrical-bore instruments. In acoustician's terms, these function as 'stopped pipes'.

Firstly, they sound an octave lower than a flute of same length, about a 6th below an oboe of the same length (because the oboe, although we refer to it as a conical-bore instrument, is not a true cone; it is truncated at the sharp end, and it completes its cone halfway down the player's gullet when it is blown). As we shall see, this factor has been a considerable advantage in the development of the use of the clarinet. Secondly, they overblow a 12th, not an octave, and therefore they need 10 fingerholes for a diatonic scale. All other woodwind have 6 fingerholes for a diatonic scale; for example starting on C:

x	o	o	o	o	o	o	x
C	D	E	F	G	A	B	C

The chalumeau would need four extra holes, one for the upper C, one for D, one for E, and one for F before it can close all holes again and overblow into the next register for the G. Therefore it added: a little-finger hole at the bottom, a thumb hole, and 2 keys. One of these keys had to act also as a speaker to help the instrument overblow, and therefore it had to compromise in its position.

The main differences between the chalumeau and the clarinet, if we are right in taking these larger Denner instruments as his improved chalumeau and not as his first attempts at the clarinet, appear to have been: providing a longer and more flared bell, improving the bore, and moving the speaker key so that now the lowest nominal (written) note was the F a fifth below middle C. Opening the keys in an approximately recorder-like sequence gave a diatonic scale up to G. Opening the speaker key gave A. Opening the front key gave B♭. Opening both keys gave B♮. Covering all and opening the speaker gave the first note in the overblown register, C above middle. This is according to Eric Hoeprich who, in *Galpin Society Journal 34* (1981), proves all previous authors, (including me) to be wrong: we have said that opening both keys gives B♭ and that B♮ is missing. You should, however, note that not everyone agrees with Hoeprich on this. Since he is not only a clarinet maker but also the best early

clarinettist around, I am strongly inclined to believe him myself. What the rest of us have said is that the reason that the clarinet acquired its third key, added for the lower thumb and covering a hole on the back of the bell, so extending the range to low E, as in Hoeprich's Berkeley instrument by Denner, and as in several other surviving clarinets, was to obtain the overblown B♮, which we said was otherwise missing.

If Hoeprich is right, why was this third key added? Hoeprich suggests that it was to move the keys to the positions that they are in on the classical clarinet so that: opening the speaker gives G♯ instead of A; opening the front key gives A instead of B♭; opening both gives B♭ instead of B♮; and opening the new third key gives B♮. Thus the new arrangement provided a good G♯, instead of having to use a rather awkward cross fingering.

Clarinet key terminology is frequently confused; some people name keys by their pitch in the fundamental register, and others by their pitch in the overblown register. It is, therefore, safest to use both, as we do in the Bate Collection here in Oxford. Then this third key becomes the E/B key. With this third key, the clarinet became a viable instrument, as may be seen with the three-key clarinette d'amour here. It was improved by adding a fourth key, which was the equivalent of the E♭/D♯ key of the one-key flute and the two- or three-key oboe, and then further by adding the second long key, which was open-standing for F♯/C♯.

The A♭/E♭ key has a forked touch on the d'amore here, the little-finger hole is duplicated, and the E/B key is placed at the

back for the thumb. All this is so that one can play either with the left hand over the right, or with the right hand over the left, just as recorder players, one-key flautists, and three-key oboists could. It was not practicable to duplicate these two long keys at the back, and therefore they had to be moved to one side or the other. It was thus with the five-key clarinet that left over right became established, and both the long keys were set for the left little finger. This instrument became the standard classical clarinet.

In England a high trill key was added, producing the six-key clarinet. In France a C♯/G♯ key was added at the bottom of the upper-body joint.

When one considers that the clarinet was invented very shortly after 1700, and when one looks at the eighteenth-century repertoire, one wonders why the clarinet was so slow to be adopted. Handel wrote for it once (a trio with horn); Telemann occasionally, Bach never, Mozart very sparingly — it only appears in two symphonies, one of them for up-to-date Paris, and in the second version of a third — Haydn was clearly suspicious of it in his first set of symphonies for London; he was told it would be in the orchestra, but he didn't really know how to write for it, and he only wrote idiomatic parts for it in his second London set and his two late oratorios.

We can only guess the reasons, but:

a) the 4-key clarinet = 1-key flute (ie it was a much more complex, and probably more expensive, instrument;

b) it was poor at cross-fingering for the more distant keys, making it necessary to have a set of clarinets in different keys such as C, B♭, and A;

c) players' conservatism. The clarinet had no background. The flute had derived from the renaissance flute; the oboe from the old hautbois or shawm; the bassoon from the curtal, but the clarinet from nothing save an obscure folk instrument.

The result was that there were few players, and therefore no music was written for it, and if there was no music, few people bothered to learn to play it.

There were, of course exceptions, with some orchestras, such as that at Mannheim, much more progressive. A much more important exception was the military band, what we now think of as the wind octet or *Harmonie Musik*, of which the clarinet was a fairly standard member (though Mozart wrote a number of sextets without clarinet, and Haydn never used it in his so far as I know). From the military band, the clarinet came into the opera orchestra, which was always more progressive than the symphony orchestra, as we have already seen and as we shall see again. Mozart included clarinets in his opera scores far more consistently than he did in his symphonies.

Mozart also wrote for it as a solo instrument, but his solo music was written for his friend Stadler personally. Stadler had a special instrument which he called his 'bass clarinet'. All normal clarinets, once the third key was provided, have a lowest written note E, which sounds, of course, according to the pitch to which

the clarinet is transposing. Stadler's instrument had an extension to the written low C, which has been proved both by documentary evidence and by analyzing the lines of the Mozart concerto and quintet, lines which are broken in the normal modern editions. Today Stadler's instrument is called a basset clarinet, but this is a modern made-up name based on the C extension which is also the characteristic of the basset horn. People are now beginning to play the Mozart solo works on this instrument.

The basset horn was invented in the mid-eighteenth century. It was a low-pitched clarinet, usually but not always in F, with a clarinet bore, that is to say narrow in relation to its length, and thus with a different tone quality from other clarinets, and with an extension to the low C sounding the F in the bottom space of the bass clef. Mozart used it especially in his Masonic works, and it seems that there was some connexion in his mind between the basset horn and Freemasonry.

Other low clarinets had been available *ab initio* as derivatives of the lower chalumeaux of which there was a complete family, treble, alto, tenor, and bass. We have already referred to the clarinetter d'amour by ISW which is our oldest clarinet in the Bate, with its thumb E/B key, forked A♭/E♭ and duplicated G/D hole. The d'amour was usually in G; the alto was in F or E♭ and was proportionately wider in bore relative to its length than the basset horn, and of course did not have the extension to low C; the lowest note was the usual E. The bass clarinet was available before the end of the 18th century, and was well established by 1810. It was

commonly a military instrument; Dumas had called his bass of 1807 the *basse guerrière*. Because it had a cylindrical bore, which was folded in half like a curtal or the butt joint of a bassoon, it was shorter and lighter than an expanding-bored instrument for same pitch, and so had an advantage over the bassoon. Perhaps a more important advantage was that its single reed was backed by a solid mouthpiece, which was much safer and stronger than a double reed on the march. Certainly this bassoon-like pattern was continued well into the nineteenth century.

It was the effect of the cylindrical bore which, eventually, led to the widespread popularity of the clarinet in all its sizes. Once players had overcome the initial reluctance to come to terms with an instrument that overblew twelfths, instead of the octaves to which they were accustomed, and to cope with the extra keys that they needed to achieve this, the range of the instrument was an immediate attraction. The clarinet overblows very easily (too easily most beginners find, which is what leads to the horrendous squeaks of an ill-controlled reed), so that the B♭ clarinet will cover the full range of the true bass flute plus that of the ordinary flute, or more than the range of the cor anglais plus the oboe. The bass clarinet will cover the range of the bassoon, and can add most of that of the oboe on top, and when it comes to the larger basses, it can do everything that the contrabassoon can do, without any of the rattle and gurgle, and on the beat rather than after it, for the clarinet speaks much more easily. It has, too, a very expressive quality to the sound, which made it fit into the ethos of the Ro-

mantic Era, and once keys had been added in the early nineteenth century, just as had happened to the flute in the 1780s, until there was one for every note, it had a greater facility in all parts of the range than most other instruments.

Iwan Müller was responsible for many improvements before 1820, introducing 7 new keys, making 13 in all. He devised new materials for pads, with pads of lambs' wool in bags of thin skin which would seal the holes much more effectively than the old flat leather pads. However, these stuffed pads could not be glued to the old flat keys, and therefore he had to invent new cupped keys to hold them. He also devised a new metal ligature to hold the reed to the mouthpiece instead of tying it on with cord. Finally, he tried to persuade players to hold the reed against the lower lip instead of the upper lip as most had done from the earliest times of the chalumeau. The point of this was that although with the reed upwards there was more control over high notes, the tone quality was hard and there was no possibility of a tongued staccato; one could only separate notes with a glottal stop, like a singer. With the reed below, there was a better tone quality; it was easy to play staccato (though clarinettists are still lazier about staccato than the other woodwind), and one could always practice for high notes.

Despite his efforts and his influence, both through his playing and through his tutor, which was one of the most influential of the period, the reed-above technique lasted well into the middle of the nineteenth century, and the metal ligature never has caught on in Germany — players say that it clamps the reed too hard,

and so string is still used even today. Various compromises such as a rubber sleeve are popular, especially in America, and one is seeing such devices more and more in Britain.

Further improvements came from Charles and Adolphe Sax, father and son, and then from Eugène Albert, also of Brussels, who devised the standard simple-system clarinet, which remained in use in Britain among amateurs and military bands into the twentieth century. Hyacinthe Klosé and Auguste Buffet adapted the Boehm mechanism to the Albert system, as it had been improved by the French flute makers. Since the Boehm clarinet was developed by 1844, this was the mechanism of the 1832 conical flute; the cylindrical Boehm dated from 1847. It is always called the Boehm system clarinet, but there is little sign in the clarinet of any of Boehm's acoustical theories of tone hole diameter in relationship to bore, so that there is little, if any, of Boehm's system about it, as may be seen from the example on display here with all the keywork removed. It was simply the Boehm mechanism that was adopted.

In Germany, the Müller clarinet was improved by Bärmann and was later remodelled by Oehler. This was as radical an improvement of Bärmann as the Klosé-Buffet was over the Albert, and it is still the preferred system in Germany and Eastern Europe.

Clarinets are available today in many sizes and keys from sopranino to contrabass; Leblanc make a set by Houvenaghel, from A♭ sopranino, E♭ soprano, B♭ treble, F basset horn, E♭ alto, B♭

bass, BB♭ contrabass, down to a BBB♭ octobass. In addition to those, there are today: D soprano, A and C trebles, G d'amore and EE♭ contra-alto, and there have been a number of other sizes in the past. The very low sizes are not much used in the concert hall (though I've often wondered why not), but the contra-alto & contrabass are widely used in recording studios. Only one octobass was said ever to have been made.

Adolphe Sax also developed a different instrument. According to the patent of 1846, this was to bring string tone to the military band, but in practice what it did was to replace the Deutsche Schalmei, (an instrument we shall meet next week but which was long extinct by then), to bring in a loud reed instrument. It was a combination of the expanding bore, the metal body, and the keywork of the ophicléïde with the reed of the clarinet. Berlioz, in his *Traité*, was very enthusiastic about the saxophone (my own translation, quoting from my *World of Romantic & Modern Musical Instruments*): "The saxophones have rare and precious qualities, sweet and penetrating at the top of the range and full and smooth at the bottom, with a profoundly expressive middle register. They combine agility with a gracious singing quality and are capable of deeply sonorous harmonic effects. The larger instruments in particular are possessed of a grandiose calm which one might almost call pontifical." Despite which, he never seems to have written for them, or at least not in works which are in the normal repertoire.

Sax produced two sets, one in alternating E♭ and B♭ for band use, and the other in F and C for orchestral use. Both sets were made in sizes from sopranino to contrabass. It is only the E♭ and B♭ set that has been widely used, and that has been for all purposes. The only one of the F/C instruments to catch on was the tenor, called the C-melody in dance and swing bands, where it played cello and bassoon parts without transposing. I have never really understood why the C soprano was not equally popular, but it never has been. The saxophone family as a whole has been tarred with its military and especially its swing association, and it has really only been treated seriously as an instrument in France where there is a fair amount of chamber music for it as well as orchestral.

The one aspect which we have all-but ignored this week, is the effect of the Industrial Revolution on the clarinet. To some extent we have covered it already, when we were talking of the different materials, the advent of the exotic woods such as grenadilla or African blackwood and ebony, woods which have been ideal for the clarinet. To some greater extent we shall cover it in the last session of this series, when we are dealing with bands.

Neither of these explain its popularity as an instrument, certainly from the middle of the last century, once the enormous fashionable attraction of the flute had begun to wane. One reason was its cheapness. The fact that the bore is cylindrical makes it much easier to make than, for example, the oboe, and thus much cheaper. The reed, a single slip of cane, is easier to make than

that of the oboe or bassoon, and it is much stronger, because it is thicker except at the very tip, than the oboe reed, and certainly it is possible to mass-produce clarinet reeds in a way that is totally impossible for oboes and bassoons. As a result it is a very rare clarinettist who makes his or her own reeds, whereas almost any serious oboist and bassoonist has to do so. It is probably the easiest of the woodwind to play, save for the recorder, and once one has mastered it, the advantages of its range add to its attraction and lead to its use in bands of all sorts and thus to the wider opportunity to play the instrument in almost all genres of music. This in its turn leads to its popularity among all types of musicians, so that as the urge to make music spreads through the population, the clarinet rides, as it were, on the band-wagon. Certainly there are no military bands without clarinets; there were no church bands without one; it is the mainstay of the wind orchestra; it is the heart of the swing band, the dance band, and the jazz band. It is, too, the one woodwind instrument which can most successfully produce a band on its own. There may have been more flute bands than clarinet bands, but the flute is even cheaper and, because it does not actually go into the mouth, that bit safer when played on the march.

8 Double Reeds

While the double-reed, conically-bored oboe and bassoon were integrated into the orchestra, and indeed into the military band, much earlier than the single-reed, cylindrically-bored clarinet which we discussed last week, this was mainly due to their lineal descent from instruments which had been used in these areas from the Renaissance, and even from the Middle Ages, onwards. The shawm band had been the Town Waits in Britain, the Stadtpfeiffer in Germany, and it was only because the shawm was so loud that its use was intolerable indoors that the oboe and bassoon were invented. Whether this happened in France, where Louis XIV's desire to take part in the Ballet du Cour made it necessary, or in Holland, we do not know. Much of the musical evidence survives in the libraries of Paris and Versailles, but most of the instrumental evidence survives from Holland, with instruments by makers such as Rijkel, Richters, two of whose instruments we have in the Bate Collection, and the English-born maker who spent all his working life in Amsterdam, Richard Haka. The reason that the evidence survives in Holland and not in France is that the French had a revolution after this date of 1660-1700, whereas the Dutch didn't, and oboes, and even more bassoons, burn nicely in cold weather.

The only problem with the new oboe was that it was ideally an indoor instrument, one which was much less useful than the old shawm for military purposes, and this was why they, now al-

most certainly Haka, had to devise a new outdoor oboe which is known today as the Deutsche Schalmei to distinguish it from the true shawms — it was a loud oboe rather than a true shawm, and it filled the same rôle in the late seventeenth and early eighteenth century as the saxophone in the late nineteenth and twentieth centuries, as a lead instrument in the military band.

There seems to have been less need for a loud reed bass, perhaps because the bassoon could play more loudly than the oboe, perhaps because such instruments as serpents were available to take the bass, and perhaps, too, though it seems to me rather doubtful, because the outdoor acoustic is less favourable to treble instruments than to basses. There were, of course, other bass instruments available as well as the serpent. The sackbut had been a traditional shawm bass, and it may have continued this rôle with the Schalmei. Certainly when, in 1784, they were trying to find instruments for the first Handel Centenary, Burney says that they couldn't find double trumpets, as trombones were then known, anywhere in England until they found them at last in one of the army bands.

There were, as we saw earlier in the Baroque, larger oboes taking a middle voice between the normal oboe and the bassoon such as the oboe d'amore, the tenor, the oboe da caccia, and the taille. These all vanished in the latter part of the eighteenth century, leaving only, and that very intermittently, the cor anglais. Mozart wrote for it in a couple of serenades (*Harmonie Musik*, i.e. military band) for ten instruments, the normal octet plus two

cors, Haydn in one symphony, Beethoven in some incidental music, but it didn't really catch on until the Romantics of the nineteenth century. Why did these large oboes vanish? We saw the answer last week: the clarinet could cover the same range more easily and more cheaply.

The oboe had become the leading wind instrument of the baroque orchestra because the traverso had not yet become fully respectable (and anyway it was not then very suitable for orchestral use) — the recorder was useless in the orchestra. It continued in this position through much of the classical period, though the flute was sometimes used in early Haydn and Mozart for slow movements (with the same players as the oboes). The Classical oboe lost a key because, by then, playing with the left hand over the right was assumed to be the normal position. The bore was further refined and the French oboe was adopted in England (cf. Halfpenny in *Galpin Society Journal* 2 and others).

The oboe, unlike the flute, did not add further keys till after 1800. This was chiefly because cross-fingering and overblowing is easier on the oboe than on the other woodwind, and there was no point in adding chromatic and speaker keys unnecessarily. The 1820s saw the advent of advanced mechanisms. The oboe added keys to its open bell vents for B♮ and B♭ to extend the range downwards (the lowest note till then always had been middle C, unlike the flute's D). Then further keys were added, 10 by 1825 (= 8-key flute + speaker & F♯ vent), and more were added as time went on

and players wanted alternatives so that chromatics could be taken with either hand and alternative fingerings.

In France, Triébert produced one oboe system after another, 8-key, 11-key, système 3, système 4, full Barret (thumb-plate & Conservatoire combined), and Boehm system. His système 3 used Boehm's 1832 flute mechanism with its brille and its long axles to reduce whip; his système 4 introduced the butterfly key for the left little finger; his système 5 is the thumb-plate system, which was introduced in about 1860 and which is still used by some players today, and his système 6 is also known as the Conservatoire system, and is still widely used. The famous player, Barret, persuaded him to devise what is now called the full Barret.

The Boehm system, as distinct from its mechanism, was tried, and it is still available from makers, though usually to special order because it was not generally popular. It produced a rather coarse tone because its tone holes were too large. Some players adopted it (e.g. Lavigne, two of whose instruments we have here), and others compromised, using a Boehm lower joint with a conventional upper joint. As one might expect, the Boehm, or more often the half Boehm, was popular in military bands where its coarser tone was less obvious and its louder sound more useful.

The cor anglais followed the oboe in its development; this has always been an essential with the larger and smaller members of a family, for a player has to put the one down and pick up the other, often with only two or three bars in which to do it, and

he can't be expected to have to think about playing a different fingering system. It became much more popular with Dvořák and the Russian and French romantics, partly for the sake of its range but mostly because of its slightly lugubrious sound.

The oboe d'amore was reintroduced by Richard Strauss, again for its sound (as the wailing baby in the *Sinfonia Domestica*); it had never died out because if you want to play the Bach Passions, etc, you must have a d'amore, whereas you can (if you must) use a cor anglais for the oboe da caccia parts. One player had a wide open bell made for his cor and used that; he was asked what was the difference between that and the normal bulb bell, and replied "Ten guineas" for that is what he charged for its use. Bach's music was a feature of the religious revivalism of the mid-nineteenth century, led musically by Mendelssohn but riding on the coat-tails of the choral society *Messiah*s, which in turn stemmed from the Industrial Revolution itself, as we have seen several times already and as we shall see in more detail in the last session of this series when we are dealing with the band and choral society movement.

The bass oboe, also known as the baritone, was reintroduced, though rarely. It is the true bass oboe; the Heckelphone, which covers the same range, has a much wider bore and bigger holes, approaching those of the saxophone. Works written for the one don't suit the other but inevitably they get played on whatever the orchestra's player has; few orchestras will countenance a hire fee for either if their contract player has the other, nor will they usually pay for a Heckelphone player if they are already paying

a bass oboe player. This makes for problems of balance because the Heckelphone is very much louder than the bass oboe, and a part designed for either one doesn't suit the other.

The normal bass, from the Baroque onwards, was the bassoon. Like the oboe, we aren't sure who invented it or where. It may have been the Hotteterres etc. in France, but it may have been Haka and his contemporaries in Holland. Although his are the best known early instruments, it almost certainly wasn't Denner in Nürnberg. Just as the oboe had derived from the shawm, so the bassoon derived from the curtal, which had itself undergone some development, from the old one-piece body into a three-joint body, of which the only example is in Vienna. The bassoon added a bell joint, though this must already have been known to Mersenne, who refers to a basson going down to B♭; the curtal's lowest note had been the written C.

The bassoon was the essential bass in the Baroque and Classical periods, even if it was often not specified — it was part of the tutti bassi. It was certainly assumed in the early classical (2 oboe, 2 horn) orchestra and should always be added in Haydn and Mozart and their contemporaries.

The bassoon started with three keys, the two which the curtal had had, though changed in their function so as to produce the D and the F, plus a key to control the hole in the bell joint for the low B♭. These were all pitches produced by closing open-standing keys — close the B♭ key and B♭ speaks out of the bell; close the D key and D speaks out of the thumb hole, which is

thus the D hole!, etc. Keys are named by the note produced when they are operated; holes are named for the note which speaks out of them, a fertile field for confusion. It added a fourth key in the Baroque for A♭, which was the equivalent of the oboe's E♭ key. The bassoon's F key is the equivalent of the oboe's C key, and the bassoon's 6-finger note G equals the oboe's 6-finger D. Everything below (above as you look at it!) the F key, is a bass extension running up to the bell.

The lathe-turning altered; on classical bassoons joints nestle closer together than they did on baroque instruments. Around 1780/90 the bassoon acquired 2 more keys, first the E♭ and then the F♯. This was the standard classical instrument, with its bell, which had been well-choked in the Baroque, evased by 1800 to make more sound. After 1800, more keys were added on the wing joint to help higher notes.

Savary worked similarly on the bassoon in France to Triébert on the oboe, adding keys for every chromatic note and improving the design, and Almenräder similarly in Germany, working with his foreman J. A. Heckel. As the mechanism and reliability of the German bassoon improved, the tone deteriorated initially. His son, Wilhelm Heckel managed to retain the advantages of the Almenräder system and improve the tone quality, though the Heckel has never sounded as lively as the French system. It is easier to play, more even, if duller, in sound, and more reliable in use.

English players used the French system (except for Hallé's German enclave in Manchester, with players such as Archie Camden) until Toscanini came with the New York Phil; the general admiration for their sound impelled players to change, and Jack Alexandra, the BBC principal, went off on holiday with his Buffet French system and came back a fortnight later with a German system, a very considerable feat considering that the fingering of the two instruments is quite different. Today players are beginning to recognise the virtues of the French bassoon (there have always been one or two die-hards who kept to it), and it is beginning to make something of a come-back.

The Boehm system has been tried on the bassoon as well as the oboe. Cornelius Ward produced a Boehm system bassoon quite early on, and Marzoli, a famous French player, persuaded Triébert to make one to his design. The trouble was that it was too successful. Much of the character of the bassoon's sound depends on its uneven tone quality which results from the long finger holes through the wing joint in contrast with the short finger holes through the long joint. The Marzoli, and Ward's system before it, has too even a tone and too open a sound, and it doesn't sound like a bassoon. The same applied to Haseneier's bassoons and his Contra-Bassophon, which sounds like a liner coming up the Channel on a foggy day.

Many problems of the bassoon remain, the most serious of which is that each octave is fingered differently and irrationally. This is mainly due to the enormous length of the extension. As

you'll remember, I said that the six-finger note of G is the equivalent of the oboe's bottom D, and the bassoon's F-key is the equivalent of the oboe's C-key. But this just takes us down to the bottom of the butt joint. The whole upward extension through the butt, through the long joint, and through and out of the bell, takes us down another fifth to the low B♭, carrying the holes and keys for E, E♭, D, C♯, low C on the second ledger line below the stave, B♮, and B♭. All these holes and keys, incidentally, are controlled by the player's two thumbs, for the fingers are fully occupied with the normal six fingerholes and keys. This long extension plays hob with the way in which notes overblow, so that a simple speaker, like on the oboe or clarinet, is very little help on the bassoon. Instead players have to learn highly complex fingerings, and there are complete books available which consist just of whole series of suggested alternative fingerings for high notes.

Giles Brindley played as an amateur; he was a scientist and a professor at Imperial College London. He didn't believe in such complexities, and he designed a new fingering system using logic circuits between the finger touches and the key pads so that the fingering would remain the same in each octave except for an octave key, whereas the keywork at the holes changed in each octave as it does on a conventional bassoon. As a result, the sound is still that of a bassoon but the fingering, like the circuits, is also logical, which is why he called it the Logical Bassoon. Its main disadvantage is that it has to be plugged into the wall or supplied with batteries for other use.

Small bassoons existed, but little music survives for them. We do not really know whether they were independent instruments, or whether they were mainly for children to learn on. The full-size baroque or classical bassoon requires a wider finger stretch than a child's hand can manage. Certainly one London player, Joe Castaldini, said that he learned as a child on a tenoroon.

The Contra was an octave below normal (as written for by Bach and Handel; we have a copy here of the unique Stanesby junior contra in Dublin, which we know was used by Handel in his *Fireworks* and other music). In the Classical period it was shortened and Mozart's and Beethoven's contra bassoon was usually a quint- or quartbass, though sometimes going down to C, as on the Tauber here. Octave contras must have been known, though, for Haydn writes down to low B♭ in the late oratorios.

The French and German contras differ just as the normal bassoons do, and for the same reasons as cors anglais and piccolos, they follow the models of the bassoons. The only difference is that while some go down to the low B♭, like the French instrument, some makers, Heckel for example, made only to low C, though he would also make to low B♭, or even, for Wagner, to low A. The Wagner bell is a vast contraption of metal which curves right down, almost to the floor, to get that bottom A.

The saxophones I talked about last week. Although in his patent Sax refers to them as providing something like a string tone in the military band, their real function was the same as that of the Deutsche Schalmei, to be a loud, outdoor reed instrument. Sax

made himself pretty unpopular in the Paris of the mid-nineteenth century. Partly because of his entrepreneurial methods, partly because of his well-organised factory, and very considerably because of his habit of swiping other people's ideas and patents. When an army bandmaster called Sarrus came up with his idea of a family of metal oboes, the bass and contrabass of which were substitutes for metal bassoons, the firm of Gautrot jumped at them and conspired with other enemies of Sax to have them adopted in the French military bands instead of the saxophones. The sarrusophones were not conspicuously successful, however, though the bass has survived in the band to this day; even then the wider bore contrebasse à anche was more popular and that instrument is still in some band instrument catalogues because it is louder than the bassoon, and has more bite than the tuba.

Like last week, I've been more or less ignoring the Industrial Revolution until now. Unlike last week and last term's session on the flute, the importation of new materials didn't make much difference to the bassoon. Most of the new woods were far too heavy for so big an instrument, and maple, which is freely available in Europe, has always been the best material for it. Blackwood has, however, become the standard material for the oboe, but, unlike the flute and the clarinet, the oboe has never been a widely popular or mass-produced instrument. This is partly because of its delicate conical bore, which makes it expensive, and partly because of its very delicate double reed which you've only got to glance at disapprovingly and it stops working. While you can go

into a shop and buy an oboe reed, no serious player would dream of doing so; all proper players have to learn to make their own, and their life is a hell of worrying how they're going to make a good reed or, if by good chance they've succeeded in making one, on how long it's going to last.

Bassoons have been much more widely used, partly because it is such an essential bass instrument, even in the village church bands, and partly because its fingering is so eccentric anyway, its bore is rather less critical and thus a potential amateur instrument is easier to make than a potential oboe. Also the reed, while still being tricky for a good professional quality, is surprisingly robust for adequate amateur use. While you can't quite drop it, tread on it, pick it up and go on using it, it's very nearly true. Also, from quite early on in the nineteenth century you could get miniature clarinet mouthpieces with a single reed for the bassoon (there's one in the showcase here), and they work surprisingly well. So the bassoon was widely popular in the amateur circles which resulted from the Revolution, and this is often why collections such as ours have so wide a range of them.

The sarrusophones are fairly rare, but then this is because they never caught on outside France except, as I've said, for the basses, which we have here, and for the contrebasse à anche. It was the saxophones which were the popular brass reeds and which were used in all sorts of bands.

Where the Industrial Revolution has had an enormous effect, as I suggested a few weeks ago, is on the reeds. The widespread

pollution of the atmosphere and of water has resulted in a very different material from that of even a few decades ago. Reed cane grows in the Mediterranean area, as a plant called *Arundo donax*. The best grows in the Rhône Valley, in southern France. If you ask any of the older players today, especially those who were playing before the last world war, about reed cane, they'll tell you that there is nothing on the market now to compare with what was available then. We go to a lot of trouble to reproduce as exactly as possible the instruments of the older periods, but the one thing that we cannot reproduce is the sound-generator, the reed that actually makes the sound. The cane is softer than it used to be, less resilient, and the sound is inevitably different.

Various makers have tried to produce reeds of artificial materials, but none of the plastic reeds so far available have been usable by a serious player. We have to hope that they will come up with something because there is a further problem, and that is the explosion of players in the last few decades, especially with the enormous increase of instrumental teaching in schools. Because the demand for reeds is ever-increasing, the cane is not seasoned for as long as it used to be, or should be, leading to further deterioration, and this problem will inevitably increase. We very badly need a good plastic reed.

9 Trumpets and Horns

As we start on the brass instruments, we realise that this, so far as wind instruments are concerned, is where the rise in technology really counts. Whatever you may do to a wooden instrument, flute, oboe, clarinet, bassoon, or whatever, you are dealing with a lump of wood, and there is a limit to what you can do to it, technologically. You turn it on a lathe, but whether it's the simplest sort of reciprocating lathe, sitting on the ground, operated by a bow held in one hand, with the tool held partly in the other and partly steadied by the operator's foot, such as you still see in all sorts of pre-technological cultures today, or whether it's the most elaborate form of machine lathe, all driven by computers, you're still putting a chisel to a piece of wood to make it round. And whether you bore the fingerholes one by one with a hand held auger or with a machine that will drill up to a dozen or more holes at once, all spinning in a preplanned pattern so that all you have to do is pull a lever and they all go clunk, you're still drilling holes in a piece of wood.

With brass it's different. Baroque horns, for example, were made by the best masters in Vienna and Nürnberg by cutting a long tapering sheet of metal, anything up to 16 feet long, about half an inch wide at the narrow end and a foot or two at the wide end, hammering it so that it curved up in a narrow trough all the way down, putting that on a long tapering steel mandrel, very thin, about 1/4 of an inch at the narrow end, turned to the shape of

the bore of the instrument, hammering the metal so that it fitted snugly round the mandrel, passing it through lead blocks to force it to a snug fit, hard-soldering it up all the way down, passing it through lead blocks again, filling it with molten lead or pitch so that it could be bent into a circle, two or three times round, and finally hard-soldering a V-shaped piece into the bell, because it's not possible to make the bell in one piece in this way. That would produce a horn in C; a horn in D would be a foot or two shorter; a horn in F would be shorter still, only twelve foot long.

Then some more intelligent chap realised that by cutting the tubing, you could make the body of the horn about 9 foot long, and make a series of shorter bits, from about a foot long to about 6 foot, which could be put between the mouthpiece and the body to change the length of the tubing, and so change key. By using a series of crooks, as these extra bits are called, you only have to make one body, with its flaring bell, and what's more important, the player only has to pay for one horn, plus a series of crooks, instead of a number of separate horns. These crooks were certainly available by about 1700 but they don't seem to have come into common use much before the 1740s or so. The earliest types of crook were a master crook, which accepted the mouthpiece, and a series of couplers which could be used, usually singly but if necessary in combination, between the master crook and the body of the horn.

A bit earlier, in the late twenties or thirties, the bore was significantly widened. Horns like the Bull in the Horniman Museum

or the Bennett on display here, are very narrow in bore with a fairly harsh sound, and Bach's use of his horns in *Brandenburg 1*, keeping them well off to one side with their hunting calls in opposition to the orchestra, shows that they were not very musical in sound. The wider bore instruments like the Hofmasters in the famous Zoffany portrait of *The Sharp Family*, which we have in the Bate, certainly came in during Bach's lifetime as one can hear in the later cantatas, the *B minor Mass* and so forth, and these had a much more mellow sound and were far more usable on equal terms with other instruments.

These crooks were joined together by a tapering push-fit at the end of one into the socket of the next, and into the socket of the horn. If you were a bit sharp, you added a straight bit of tubing from an inch to three inches or so long, called a tuning-bit, between the mouthpiece and the master-crook. This was all a bit shaky, and anyway the contracting taper on the end of each bit and the end of each crook spoiled the shape of the bore which was otherwise supposed to be an evenly expanding cone. More seriously, because the master crook could be used by itself and therefore ended with a fit into the body of the horn, whereas the couplers had to fit between the master crook and the horn, this meant that whereas the master crook was expanding in bore, the couplers had to be cylindrical in bore, and this of course really did wreck any idea of an evenly expanding bore.

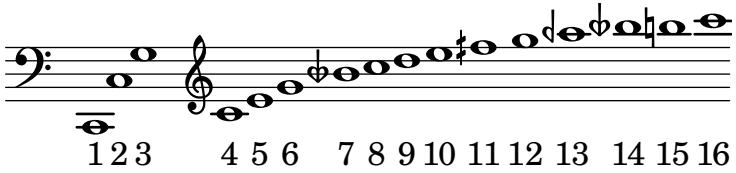
The answer to that problem came with the increased technology that we've been speaking about all the way through this series:

the tuning slide. Slides, of a sort, had been used since the Middle Ages (if, as I do, you believe in the existence of the mediæval slide trumpet; be warned, though, that this is a controversial subject, and see some of the articles for and against the existence of this instrument in the pages of *Early Music* and the *Galpin Society Journal*), and anyway since the invention of the sackbut, the early trombone, in the fifteenth century. These, however, were loose-fitting slides. One piece of tubing was a loose enough fit over the other that it could slide up and down quite freely. It is surprising how loose a fit will still work, without feeling that you have a leak in the air column. The tuning slide is quite another matter. It has to be a tight enough fit that when put into position it'll stay there, and yet not so tight that it'll jam. A loose-fitting tuning slide is a menace; I had one once, and it was loose enough that as one blew one could see it rise slightly from its position under the pressure of the air. A jamming slide is worse; all brass players have met that one, and debated whether to try to pull it out themselves, with the risk of pulling the instrument to pieces, or going to a repair man with so simple a job. The ideal is a slide tight enough that with a thin coating of grease it's completely airtight, tight enough that you'd get a pop when you pulled it right out. This is fairly tricky to make. To start with it has to be perfectly round in section. It has to be thin, to avoid unwanted steps in the bore, quarter of a millimetre or less. The other half of the slide, whether we're talking about the inner or the outer, has to be so slightly larger or smaller bore diameter that even an eighth of a millimetre may be

too wide a difference for a good fit. And of course both the inner and the outer must be perfectly straight and perfectly smooth; any bends or dents, however small, are going to make it jam.

This could not be achieved before the Industrial Revolution proper, with precision machinery, had started. This is why it was not until 1785 that Richard Potter could devise his tuning slide for a flute, which works on exactly the same principle, and it's at about the same date that one starts to find horns with a tuning slide.

It was a bit earlier than this, in the middle of the eighteenth century that Hampl invented hand-stopping, partly closing the bell of the horn with his hand. This came about by accident; he was experimenting with cloth pads in the bell to see if he could produce a better sort of mute, and he discovered that by more or less closing the bell he could produce different pitches. Before that, players had depended entirely on lip control to select any one of the first eighteen or twenty partials of the harmonic series, and it was only possible to play diatonically up in the top register, called the clarino register when it was on the trumpet, from the 8th partial upwards. Up there, it was by no means easy to hit the harmonic you wanted, rather than one of its neighbours, and distinctly difficult to lip the 11th partial, which is halfway between F and F♯, either up or down a quarter tone according to which you wanted, or to get the 13th, a very flat A, sharp enough to sound as though it was in tune.



The Harmonic Series

Once Hampl had made his discovery that the hand in the bell flattened the pitch, it became possible to play the notes in between the 4th and 8th partials. The result was that the horn became fully diatonic and partly chromatic in the middle octave. The problem was (there always is a problem; in fact you're lucky when there is only one) that there was a considerable tonal difference between open and stopped notes. Players therefore took to playing quite quietly, with the horn partly stopped all the time, so that the sound was as even and equal as possible. The horn therefore totally changed its character; where it had been an ebullient instrument, belting out its hunting calls in the *First Brandenburg* or feeling happily at home at an outdoor *Fireworks* party, it became the sort of instrument that Mozart wrote his concerti and quintet for.

There was, however, another problem. With the old style of master crook and coupler, when one needed to add more couplers, the mouthpiece got further and further away from the horn.

At one end, the mouthpiece is on the lips; at the other, the right hand was never in quite the same position, which makes hand-stopping difficult. As a result, except occasionally in England, where we tend to be a bit old-fashioned at times, players abandoned the old master crook and couplers and went in for a complete set of terminal crooks, each of which would accept the mouthpiece, with one for each key that one was likely to meet. The normal English and French set was from B♭ alto down to B♭ basso, but in Eastern Europe almost all horns had a C alto crook (often demanded by Haydn for instance). The A♭ crook was very rare (I only know one example of its use, in Schubert 4, though Verdi was a bit prone to write for A♭ basso, a crook I've never seen or heard of), and so was the F♯, again with only one use that I've met (Haydn *Farewell*). Crooks proper usually finished, with the C basso, with two couplers, one for B♮ basso and the other for B♭ basso, but one does occasionally find a separate B♭ crook; we have one here in the Collection. I've never seen a B♮ basso crook, but they may well have existed occasionally.

For soloists there was still a problem; lip to hand distance might be the same now, but there was always the risk of a wobble of the crook in its socket, and a wobble in the socket usually means a cracked note. For them, makers produced the cor solo, which had a fixed mouthpipe with crooks in the tuning slide. Because concertos etc. were only written in a few keys, there were only a few crooks, usually from G down to D.

These two instruments, the orchestral horn with its full set of crooks and the cor solo with its handful of tuning slide crooks, were the horns for Mozart, Haydn, and Beethoven, and they continued certainly down to Mendelssohn and early Wagner. Composers with old fashioned ideas, like Brahms, certainly always thought of the horn as a hand horn (he wrote his Trio Op. 40 with the hand horn firmly in mind), even if his players were, as we shall see next week, using valve horns. This means that all non-harmonic notes were normally played on the hand. When Beethoven wrote a sforzando on an 11th partial, as he often did, the result was a rasping sound, the same as when Mahler put a plus sign over a note, an effect which is lost today. However, as an evil compensation, when players in our early music orchestras use their hands in baroque music, as they far too often do, you hear that same snarl in Bach and Handel, an effect which we would be only too glad to lose. The exception to playing all non-harmonic notes on the hand is low notes, for example in some Haydn second horn parts and, for instance, in *Beethoven 7*, where the player would lip the note down. This is the point at which I want to leave the horn for this week and turn to the trumpet and the trombone.

The trumpet and trombone were the first wind instruments to be established in their baroque form. In the case of the trombone this was because the instrument was perfect from the beginning; in that of the trumpet, it was partly due to the imperfections and the natural limitations of the instrument; below the 8th

partial, only fanfares are possible; only above the 8th partial do diatonic melodies become possible. By 1607, the date of Monteverdi's *L'Orfeo*, trumpeters could reach at least the 13th partial and must already have acquired the technique to lip the 11th & 13th into tune. No-one in their senses can claim that composers wrote notes that they knew would be played out of tune in the hope that one day someone would invent a mechanism that would allow them to be played properly, despite which a number of authors have done just that!

The trumpet became the most important baroque brass instrument. Its use in Germany was rigidly restricted to members of the Trumpet Guilds. It could only be played by guild members; guild members who caught non-members playing the trumpet were entitled to have their trumpets smashed and their teeth bashed in so that they could never play again. Entrance to the guild was only by rigidly restricted apprenticeship, often restricted to the children, and particularly the orphans of other guild members. In addition, trumpeters could only be used by licence, and licences were restricted to certain upper classes of the nobility, to licensed regiments and to licensed towns, and even within such towns often to licensed occasions. It is instructive to work out on which occasions Bach could use trumpets in cantatas. The use was less restricted elsewhere than in Germany, but everywhere the trumpet was associated with royalty, pomp and ceremony.

The trumpet was also a chamber music instrument — in *Brandenburg 2*, for example, it was on equal terms with recorder, oboe

and violin — recorder, not the Boehm flute; baroque violin, not a modern one with steel strings, and it did not drown them. This was especially true in Germany where there is much other repertoire, in Italy with Torelli's and other's sonatas, and in England where the Trumpet Overtures, for example by Purcell, were common.

There were already attempts at producing chromatic trumpets. Talbot describes the flatt trumpet with a backward-moving slide, which was demanded by Purcell in his *Queen Mary Funerall Music*. Without such a device, there is only a very limited possibility of playing in minor keys with the natural harmonic series. The tromba da tirarsi, with a long mouthpiece stem to slide out in the first yard, was known in Germany, and Bach used it in chorales. It is probable that this was a non-guild trumpet which could be used without restriction. Both the flatt trumpet and the tromba tirarsi were only suited to slow music because waving a trumpet around on the end of a long mouthpipe makes it difficult to maintain a good embouchure. Bach calls sometimes for a corno da tirarsi, and nobody has ever worked out what this was. The tromba da tirarsi simply has a long mouthpiece stem, extending far enough into the mouthyard to lower the pitch by a tone or two. Where can you put such a slide in a coiled horn? Bear in mind that for even one whole tone on a tube as long as a horn it's got to be able to move at least eighteen inches, and for a third twice that.

The clarino technique, the ability to ascend as high into the harmonic series as Bach and his contemporaries demand, began to die out from the 1750s. We do not know whether it died out because the guilds were breaking up and the necessary long apprenticeship was no longer popular or available, or whether the guilds broke up because no one wanted clarino playing any more. Certainly musical tastes were changing, and classical parts seldom go above the 12th partial. The horn became a more important instrument than the trumpet; it was quite easy to play the handhorn diatonically, so why strain on the trumpet to attain the clarino register? In fact, the clarino technique survived longer on the horn than on the trumpet with works such as Leopold Mozart's Concerto, Rosetti's Concerti, some lethal Haydn parts such as those in Symphonies 31, 99, and others, some works by Dittersdorf, and so on.

The trumpet itself was built in C around 1600 (though it sounded *tono più alto* with a mute). By 1700 it was built in D and by 1750 in E♭, with crooks down to C. There it stayed, with E♭ as its shortest, and thus highest pitch (note which keys Haydn and Mozart used trumpets in), until about 1800, when the F trumpet became available, now with crooks down to B♭, the same length as the tenor trombone and the key that Beethoven uses in the *4th Symphony* and the *3rd Leonora Overture* trumpet calls. The scoring of his *7th Symphony* makes it clear that Beethoven had no A trumpet; he had to use one in D as the nearest available key.

Hand-stopping was used on the trumpet, which was curved into a half-moon shape to bring the bell within reach of the hand, but it was not really very successful tonally; the bell is too small for it to work really well. Much more successful was Weidinger's key trumpet which was certainly in existence by 1798 when Haydn wrote his concerto for it. It continued in use well into the nineteenth century, and it seems likely that many of the low trumpet tunes in the early Verdi operas were written for it, for we know that it was used in Italian opera houses into the middle of the nineteenth century. Hummel's concerto was written for it, too, and players such as Crispian Steele-Perkins have revived it for use in these concertos. It is thought that it may have derived from the mysterious Amorschall which was invented by Kölbel in about 1760. This was a horn with two keys down by the bell on which Kölbel was said to have been able to play any note. Unfortunately no such instrument has survived and we have no better description of it. The flatt trumpet with its backward-moving slide was reinvented in England in late 18th century by John Hyde and the slide trumpet became the standard nineteenth-century orchestral instrument in England and remained in use by the best players almost into the twentieth century. The great advantage of this instrument was its slide which, while not long enough to produce a full chromatic range, allowed players to produce an in-tune upper F♮ by flattening the 11th partial, an F♯ by flattening the 12th, an A by flattening the 14th, and an occasional B♮ and A in the middle of the range by flattening the 8th and 7th partials. Because the

top players used this instrument for their *Messiahs* and standard classical orchestral works, the basic clarino technique, save for the lipping of the bad partials into tune, remained a feature of English trumpet playing almost into living memory.

The trombone has existed right through from the early 1500s to the present day with minimum change — practically only to the bell shape with the later addition of stockings on the last two or three inches of the slide legs and a spit key. It was fully chromatic right from the beginning and it is the only wind instrument (plus, I suppose, the swannee whistle) that can be played perfectly in tune. In its earliest days it was the bass to the shawms, but after the demise of the Alta Band it was used mainly with voices and with the cornett. Later it came into the military band and thence into the opera orchestra and then to the symphony orchestra in nineteenth century. In the seventeenth and eighteenth centuries it was mainly used only for church music and supernatural scenes in the opera (Pluto in Hades, the Commendatore once he was dead, and so forth).

There were three sizes, alto, tenor, and bass. In the nineteenth century there was spasmodic use of a soprano (there's one on display here) and, especially for Wagner, the contrabass. The treble was not much use because the slide was too short and the tone not very good; the contrabass is really too narrow for its length, it was too heavy to carry, and too far to reach the lower positions of the slide, until the invention of the double slide of King Kong as this model was called by the rest of the orchestra. The trouble

with this instrument is that, in the hope of getting a better tone for its length, the slides are expanding by step, each leg being wider than the one before, and if this is carried to its logical conclusion the bore would get so wide that one is in danger of introducing a slide tuba, with a quite different tone quality.

In 1815, the Irish bandmaster Haliday took an ordinary duty bugle, which was single-coiled in his period, cut some holes in the tubing and covered them with woodwind-like keys, so inventing the key bugle. He may well have got the idea from the serpent, which had been used for a very long time in the church. Serpents had come into the military band with three keys before the end of the eighteenth century and, during the early years of the nineteenth century, they were modified and modernised. For military use, the serpent was fairly clumsy (it banged against the knees), and there were various attempts to make it more portable by devising upright models which would be easier to hold, which led to the various bassons russes, bass horns, serpent de cavallerie, etc. There were also attempts to render the serpent more chromatic by adding more keys, eventually one for every note of the chromatic scale. The result of this, as Reginald Morley-Pegge pointed out in the old *Grove 5*, was that they provided a wider range of out-of-tune notes. The nature of the serpent is that every note has to be lipped into tune, far more than any other instrument save for the cornett; the more notes that you have available, the more have to be lipped in tune, or not as the case may be. If you are so

unskilful that you need a full set of thirteen keys, all those notes will, inevitably, be out of tune.

The French maker Hilaire Asté, who used the trade name of Halari, took Haliday's key bugle and made it into a family, the bass member of which he called the ophicléïde, a barbarous coinage from Greek *ophis*, a serpent, and French *cléïde*, keyed. The English quickly changed the pronunciation to ophicleide, dropping all the accents. Ophicleides and serpents remained orchestral instruments into the mid-nineteenth century, appearing in scores by Mendelssohn and Wagner as well as others.

We have referred little to the Industrial Revolution today, save at the beginning, but we have set the scene for its full effect on brass instruments, which we shall be discussing next week. One has to remember that the use of natural brass ran on surprisingly late; Brahms was writing with hand horns in mind; Wagner wrote for both natural and valved horns and trumpets; we still hear natural trumpets in the Household Cavalry; Kipling refers to key bugles in a story written in 1913; Thomas Hardy often refers to the serpent, for the church band, in which it commonly appeared, was still a living tradition in his time.

10 Valved Cornets and Bugles

Last week we saw the hand horn with its full set of crooks — it was heavy, cumbersome, and a nuisance. One solution was to build all the crooks in, and the resulting omnitonic horn, as it was called because it played in all keys, was available from about 1815. Its advantages were that it maintained all the character of the handhorn, for players still had to hand-stop the non-partial notes, and that it was fully reliable. Its disadvantages were that it weighed a ton and that it cost a packet. Initially it was fairly successful, and various makers went on devising such systems at least up to the Great Exhibition, at which Callcott's Radius Omnitonic Horn, here in the Bate, won a prize.

A far more successful solution was to build in supplementary tubing with valves, initially with two, for a semitone and a whole tone. Then :

the B♭ alto crook with semitone valve = A crook
whole tone = A♭ crook
both = G crook
the F crook with semitone = E crook
whole tone = E♭ crook
both = D crook
and this covers most of the range commonly used.

Heinrich Stölzel, who was a horn player, announced his invention of valves in 1815 and he was granted a Prussian patent for them with Friedrich Blühmel, who may also have been a horn

player and was certainly a wind player, in 1818, as square box valves. Many details, including the original patent, have been lost and there is no known surviving horn with square valves. Few very early valve instruments or types do survive, and the next type to do so is American, the twin-vane valves invented by Nathan Adams in 1825.

The first successful piston valve was Stölzel's second model, a narrow cylindrical piston, which certainly existed by 1826 when Spontini sent a set of instruments with Stölzel valves to Paris. These were followed by various rotary valves, one by Blühmel in 1828, another by Kail in 1829, and in 1832 Riedl's Radmaschine, which is in all essentials the rotary valve still used today. Other types of valve followed, in 1830 Uhlmann's double piston, the Wiener Ventil which is still used in Vienna today and which is regaining popularity elsewhere; even Yamaha make a model of the Vienna horn. In 1833 Wieprecht introduced his short-stroke piston Berliner Pumpen, which Berlioz confusingly called cylindre in contrast with the Stölzel and Périnet pistons, and in 1839 Périnet produced his medium-stroke piston, the piston valve which we use on many of our instruments today.

So within 25 years from Stölzel's initial announcement in 1815, all the important types of valve had been invented. There were, of course, others also, such as Shaw's disc valves which can be seen on a couple of cornets on display here, and many more followed during the nineteenth century which there is no time, nor particular reason, to describe.

A valve is a fairly complex piece of mechanism which requires precise manufacture. A metal cylinder must be made, which will fit sufficiently exactly into its casing that air cannot leak up the sides, but nevertheless it must be able to move freely up and down without jamming. Within that cylinder there must be various passages which will lead the air into and out of the supplementary tubing, and the ports, the openings of these passages on the surface of the valve, must align precisely with the ports of the supplementary tubing both when the valve is up, in its position of rest, and when depressed. None of this would have been possible without all the mechanical advances of this period. Nor would it have been possible without very exact knowledge of the melting points of various types of solder, for you cannot solder things together which are themselves soldered, unless each operation is conducted at a temperature safely below that at which the first, the second, or the third, joint was made.

There are several basic problems with valves. They tended to be sluggish, especially for rapid reiterations, so much so that McFarlane devised a key for trills, always referred to as McFarlane's clapper key; it works surprisingly well. Valves involved sharp bends in the tubing, which upsets the air column and spoils the tone. They also involved constrictions in the tubing, which also spoils the tone. Most seriously, they produced bad intonation when used in combination.

The first, the sluggishness, was improved with better technology and materials, though C. R. Day in 1890, in the *Royal Mili-*

tary Exhibition Catalogue, said that the key bugle worked better than the valved cornet. It is still being improved, for any modern advertisement for a new brass instrument will almost certainly mention the wonderful new material from which the valves are made, or with which they are plated.

The second, the sharp bends, was improved with better designs and by leading the tubing round in a wider curve, though some corners remain inevitable, especially with the rotary valve.

The third, the constrictions in the tubing, which often come where one coquille, the windways within the valve piston, passed over another, was improved with designs such as Higham's clear-bore, down which, he claimed, a pistol ball could be rolled.

The fourth was and remains the most intractable. An F horn about 3.75m long requires about 25cm of extra tubing to lower the pitch by a semitone. The result is a horn in E about 4.00m long. Suppose that we want a D horn, a tone and a half below F. Our F horn about 3.75m long would have required about 46cm to lower the pitch by a whole tone, but the E horn about 4.00m long which we have now, requires about 50cm for a whole tone. The result is that the combination of tone and semitone valves is 4cm too short. This is why a third valve, long enough for a tone-and-a-half, was added, to avoid using first and second valves in combination. BUT the C horn, two-and-a-half tones below the F, was also used, and the combination of first and third valves is 10cm too short.

In fact, all this was, and is, not a problem with the horn because players use their hand in the bell to tune it. But it was a very serious problem with other instruments. Hence the trigger and/or 3rd valve ring on the trumpet, which are cheap to make and easy to use; the only disadvantage is that the player has to remember to operate them. Hence all Blaikley's work on complex compensating systems, which has the advantage of working automatically. Whenever more than one valve is depressed, both ends of the extra compensating tubing are open, and that much extra tubing is added. When only one valve is used, the other end of the compensating tubing is blocked, so that the air can't pass through it. Hence also other compensating systems such as Besson's régistre, which requires the deliberate use of an extra valve. Hence, too, Sax's attempts to combine the use of valves and keys, and hence also Sax's invention of horrors like the well-known contemporary engraving of the six independent valve system looking like a player surrounded by snakes. Each piston led to its own bell so that there was never any combination of tubing. The real instrument looked more reasonable. Hence also the use of extra valves to avoid combinations: some, such as the six-valve horn, require more fingers than the player has available and so are unpopular; others, such as the thumb valve on the euphonium and tuba, are successful and widely used. Of all the other ideas, only the trigger and/or ring, if the shape of the instrument makes them possible, and compensators are successful and in use today.

Once they had been invented, valves were used on other instruments beside the horn, as we have already seen. The coiled cornet de poste with its set of crooks, which Mozart scored in his *Posthorn Serenade* K.320 and in German dances, became the cornet à pistons. The bugle became the flügel horn. The natural trumpet became the valved trumpet. Even slide trombones became valve trombones.

The result was four families of valved brass: Horns, Trumpets, Cornets, and Bugles. In the nineteenth century, the divisions between them were fairly plain: the horns were expanding in bore except through the valves and tuning slides. Trumpets were cylindrical except for the bell section, as were trombones, whether they were valve trombones or slide trombones. Cornets were narrowly expanding down to the tenor horn and the baritone. Bugles were widely expanding down to tenor and euphonium, and on down to the tuba.

Today things are rather different: horns are cylindrical except for the lead pipe and bell section. Trumpets are expanding except for the valves and tuning slides. So far as the trumpet was concerned, the main reason for this is that the trumpet has got more and more like the cornet. The 19th century trumpet, whether natural, slide, or valve, was in F, 6 foot long. It still read middle C as the 4th partial, sounding the F *above* middle C. It was difficult to play because the partials are close together in the upper part of the range. Most of the trumpeters of the day were also playing the cornet, crooked from four-and-a-half foot B♭ downwards. This

was much easier to play because players were reading posthorn and bugle notation in which middle C was the 2nd partial, sounding B♭ *below* middle C, with the result that there were wider gaps between partials. This is why the trumpet became more and more like the cornet; players wanted to read music for both instruments in the same way, and they wanted both to behave in similar ways. As a result, today, the only difference between the two instruments is a somewhat different mouthpiece and about a sixteenth of an inch in the diameter of the mouthpipe. Several trumpeters say that the sound of the two instruments should be as nearly the same as possible, with the result that when authentically minded people try to use both trumpets and cornets in French music, where both often appear in the same score, there is very little difference to be heard, unless of course they have the sense to get a brass bandsman to play the cornet, where the true cornet sound still survives; in Western Europe, the true trumpet sound is as dead as the dodo. The German orchestral players still use the rotary valve trumpet with a cylindrical bore (they refer to ours as a Jazztrompete), and that does still have something, at least, of the true trumpet sound.

The nineteenth-century horn was also in F, but twelve foot long. Despite the theory of using valves as crooks and hand-stopping for non-harmonic notes, most players had the sense to use their valves for all non-natural-partial notes. There had been much opposition to the general use of the valve horn from everybody except the players, complaining of the loss of the true

character of the horn. This was because, if one uses the valves, there was no need to stop down for all notes to avoid the differences of tone quality between stopped and open notes. All notes were now open notes, either natural partials of the basic tube or valve notes. So players changed their hand position, opening the bell more, and the old veiled sound of the horn was lost. This was partly a matter of convenience, but mainly so that the horn should become louder as all other instruments did; our old problem of the larger concert halls demanding a louder sound. Some composers were old fashioned, Brahms for example, who always wrote his parts as though they were to be played on the hand horn. Wagner's parts look as though he did, too, but he did not actually expect players to change their crook between two notes; he wrote his parts as he did because they were easier to read that way since they make harmonic sense and make it easier to pitch the note. Players tend to read brass parts as though they were Tonic Solfa; see a D a ninth above middle C and hear a supertonic in your mind. You can't do that with modern horn parts, but with Wagner's parts you can, because the written change of crook tells you what key you are in and the written note tells where you are within that key.

Seeing the advantage of the B♭ trumpet, Kruspe of Erfurt invented the double horn late in the nineteenth century. Its tube length was the nine foot necessary for the B♭ alto horn, plus three foot of extra tubing for the F horn controlled by a thumb valve. This extra tubing was obviously cylindrical because both ends of

the three-foot extension had to match-in to one point of the existing tubing at the thumb valve. This much cylindrical tubing, the three-foot for the F extension, plus the two foot or so for the tuning slide, plus all the valve slides, changed the sound of the horn even more and led to further complaints, again from everybody except the players who were only too glad to have this much help in getting the right notes. The advantage of the double horn is that concert (or sounding) F on the top line of the treble clef is either played as a top C on the F horn (the 16th partial), or, on the B♭ side, as a space-above-the-stave G (the 12th partial). The process has continued further, and Paxman has introduced the triple horn, which can be in F, B♭ alto and F alto, on which the player can produce the same pitch as the C above middle C on the F alto side (the 8th partial). Alternatively, the triple horn can be in B♭ alto, F alto, and B♭ altissimo (which is also called the B♭ piccolo), and on that this same high F sounding can be played as a dead safe second line G, a 6th partial. The fact that the sound of the B♭ piccolo is filthy, resembling that of the flugelhorn, which is the same length and shape, unless it is very carefully played, is disregarded today — right notes are all that matter, especially in the studio, where a single cracked note can cost thousands of pounds if it means a retake in overtime or a new session.

Much the same thing has happened to the trumpet, but this was due to the Bach revival. Kosleck designed a long A trumpet with a straight tube, a semitone below the modern B♭ instrument, for nineteenth century performances of the *B minor Mass*, and

the English players, who had been happy with the F slide trumpet crooked into D in Handel but who couldn't cope with the much higher tessitura of the Bach parts on that instrument, followed his example. We have an example of this in the Bate, which was used by John Solomon in the first performance of the *B minor* in London. This was followed by the introduction of the so-called 'long D', called that because it, too, was a straight tube rather than a folded one, which was an octave above the true D trumpet of Bach's and Handel's time, to make the parts easier still. Then came the folded D, then the piccolo B♭ (two octaves above the *Leonora 3* B♭), which wasn't folded because there was nothing to fold; it is only 2′3″ long, the mouthpipe going straight into the valves and the valves straight into the bell.

These changes are for safety, not for ability. If you can't play the pitch on the long tube, you aren't likely to get it on the shorter tube. But if you can get the note, then it will be much safer on the shorter tubing, and safety is essential today for two reasons: a wrong note, as I've already said, can cost thousands of pounds if it means running into a second session, and players have to dash from rehearsal to recording to teaching to concert, with no time to practise properly if they are to earn enough to live on. This is also why players of 'baroque' trumpets use the fingerholes, and why 'baroque' horn players put their hands in the bell — one cannot play modern instruments one day and early instruments the next, and in the baroque period, nobody was trying to.

Wagner was very influential with the heavy brass, for example the contrabass tuba. The initial tuba was either in nine-foot B♭ or eight-foot C, the same size as our euphonium. Moritz introduced the twelve-foot F tuba, which was the orchestral equivalent of our E♭ bombardon of the brass and military bands. Wagner called for the sixteen to eighteen foot CC/BB♭ contrabass for his Ring operas. He also asked for an instrument intermediate between the horns and the tubas, probably with Sax's saxhorns in mind, but Moritz produced the instrument we call today the Wagner tuba.

Brass tubing can be coiled into pretty well any pattern, almost as easily as spaghetti, and bass tubas were also coiled helically for military use because the weight can be carried more easily on the shoulder than in the arms when one is marching. The sound of the helicon projected sideways, which was undesirable. John Philip Sousa, the great American bandmaster, invented a dog-leg in the bell section, the result of which was that the bell pointed upwards (the instrument was always called the rain catcher), and the sound also projected upwards, which again was undesirable. He then inserted a second dog-leg so that the bell and the sound projected forwards, and the sousaphone was finally successful.

Wagner was not the only influential composer — Verdi insisted on a special trumpet for Aida with one valve and built in B natural.

The social results of all these changes was enormous. The old natural instruments, horn and trumpet, could only be played

by players with long training and much practice, whether they were the product of the restrictive German guild systems or other methods of apprenticeship and training. The renaissance cornett required similar expertise. The shorter natural instruments, the cornet de poste and the bugle, were very limited in their range and their expectation, and were played chiefly by people in the relevant trades, with the minimum of musical training or skill. The introduction, which we saw last week, of the serpent in all its forms and manifestations, and the key bugle and its larger relative the ophicleide, opened the possibility of melodic playing on brass instruments which required very little more skill, though more musical training, than the old posthorn and bugle. Such openings were widened enormously by the introduction of valved cornets and bugles in all their sizes, and this coincided with the enlargement of the military bands and, more importantly, with the freeing of trades and the introduction of factories and the rise of the manufacturing towns and cities. The full results of this we shall consider in a fortnight, in the last of these sessions.

11 Percussion

At the beginning of the Baroque period there only two percussion instruments of any importance: the timpani in the trumpet chorus, and the side drum in the military band.

The side drum was still used as it had been in Arbeau's and Mersenne's time to mark each pace of the march, and for alarms and other signals, and these two uses continued so into the nineteenth century.

We know very little about other military percussion instruments at the beginning of the eighteenth century: Cymbals were probably used; Tambourine may perhaps have been used; the Long drum was maybe beginning; the Timpani were certainly used.

The timpani were carried on horseback in cavalry regiments, and hence, we think, the use of the internal 'trumpet' bell or Schalltricht, a trumpet-bell-like tube standing up inside the drum from the airhole in the base of the shell. We are not at all certain what the purpose of this device was, but a pair in the Smithsonian Museum in Washington were tested first without their 'trumpets' and then, after restoration, with them, and the result appeared to be that with the 'trumpets' when one struck the drum near the centre, which usually produces a very poor tone, the sound was as good, or very nearly, as when one played at the proper spot, three or four inches in from the rim. When one is playing on horseback, with the usual showy technique, swinging the arms about,

it's not easy to aim at the proper spot, and these 'trumpets' allowed the drummer, if our conclusions are correct, to land anywhere on the skin. One could contrast this with the very nasty sound produced by our own Household Cavalry, whose drums do not have such 'trumpets' (they seem to have been confined to the German states), so although I would emphasise that nothing about this is certain, it does seem very probable, and I'm very grateful to Bob Sheldon for allowing me to use this information.

The artillery used larger drums, because they could be drawn in a chariot as part of the Train of Artillery instead of having to be small enough to carry on horseback; we will return to these shortly.

Timpani were also civilian instruments. They still acted as bass trumpets, providing the bass for the trumpet squad; their parts were still usually improvised, and their presence can still usually be assumed when there are trumpets in the music. They were played with wooden sticks and they were usually quite small and shallow. With a few earlier exceptions (Lulli, occasionally Purcell, and others) composers such as Bach and Handel began writing specifically for timpani not long before 1700. Timpanists were still expected, if not to improvise their parts, at least to elaborate them. If one compares the Mozart edition of *Messiah* with Handel's original, one can see that, because this tradition was all-but dead by then, Mozart had to write out what Handel's drummer would have improvised.

For special occasions, Handel used to indent for a pair of large artillery drums from the Armouries of Tower of London. These were known as double drums, and we have in the Bate the only known surviving pair. Burney describes them in some detail in his account of the 1784 Handel Celebrations. Drums of this size were played with heavier wooden sticks because the weight of the sticks must match the size of the drum. They were tuned with a loose key, a technique which was inevitably slow and noisy. The key had to be fitted to each block in turn, often with a clank, turned, removed, put on the next block, and so forth. By the end of the eighteenth century, timpani were usually fitted with T-handles, which were still slow, though by no means as slow as is sometimes thought, and of course turning these did not make any sound. Until Beethoven's time one never had to tune during the music, except to touch up a drum that had wandered off pitch, and one only had to tune in the trumpet keys, normally C and G, D and A, and E♭ and B♭, almost always a fourth apart, and just occasionally a fifth if the notes had to be inverted due to the sizes of drum available. Beethoven introduced the use of the tritone, octaves, and other more awkward intervals.

In the early nineteenth century, various methods for quick tuning were introduced, especially for the opera orchestra, where quicker changes have always been needed than in the symphony orchestra; one wonders how horn players managed to change crook. When one considers the vast number of bars rest that Beethoven provided for his first horn to change from the E♭ crook

to the F in *The Eroica*, one wonders how players managed in the opera when there were only one or two lines of dialogue between arias in different keys? Of the early quick-tuning methods for timpani, Cramer devised a single handle system in 1812; Carl Stumpff produced his rotating drum in 1821; Brod invented his concentric rings about 1830; Einbigler introduced his tram-handle mechanism about 1830; Cornelius Ward patented his cable mechanism in 1837, and Pittrich produced the first pedal timpani in 1881.

Of these:

The rotating drum was a failure because when one rotates the drum, the playing spot moves away from player; there is always one place on the head which produces the best tone quality. Nevertheless, various makers have tried it, and drums of this type are still seen, with the whole drum screwing down or up on a central threaded rod.

Brod's concentric rings were also a failure because the system was too complex and because it meant playing nearer and nearer the centre of the drum, though other makers have tried it, such as Gustave Lyon. What happens is that by moving a lever, an internal ring, smaller in diameter than the drum shell, moves up and presses against the skin, so producing a smaller diameter and thus a higher pitch. Another lever does the same further in, and so forth.

The Einbigler tram-handle, with a single handle (like that which used to be used as the driving handle on tram-cars) to con-

trol all the screws round the drum, was the first really successful system because the drum was free from mechanism and thus the shell was free to vibrate. It is still widely used, partly because four pedal timpani are awkward to get at with only two feet, so that, with a set of four timpani, it is often easier to have two pedal timpani in the middle and two tram-handles on the outside. One disadvantage is that these drums are very heavy and need two or three men to shift them.

The Ward patent was very popular in England and it is still used in the Household Cavalry. The drums are very light and easy to carry one in each hand, and thus not too much burden for the horses. They have an internal wooden bar which travels on a diametrical metal rod with an external handle to turn it, linked with a wire cable to each of the tuning brackets on the outside of the drumshell.

The first pair of Pittrich pedal drums in Britain were imported by Henry Wood about 1905 and were scored for in his transcription (under the name of Klenovsky) of the Bach *D minor Toccata & Fugue*. They are still widely used in Germany, and many of the original vintage are still in use.

Pedal timps like these, which are sometimes called Dresden drums (they are a very characteristic shape), were not the final answer for timpani mechanisms. Their main problem is that they were very heavy, with cast iron frames, and not easily portable. Hence the invention in America of Leedy's model, which come apart into drum and pedal, are not too heavy, and will fit in a

car, and later the Ludwig model which, while not as convenient as the Leedy, are not too difficult to carry and have, because of their deeper shell, a rather better tone quality. With both models, because the mechanism is internal, the tone quality suffers, and because of the shallow bowl, particularly of the Leedy and even more of some more recent models, the tone quality cannot compare with that of the Dresden drums, but few people worry about that today; there are one or two orchestras, even in London, that do use Dresden-style drums at the insistence of their timpanist. Ludwig introduced a so-called Dresden pattern, but the tone was little better than his ordinary drums.

In the late nineteenth and earlier twentieth century, the English pattern such as the Hawkes/Cummings hand-tuned model was far preferable for tone to anything except the Dresden drums, and Parsons of Birmingham would fit pedals to one's own drums, but the result was a very awkward height.

Space is always a problem, especially in the theatre pit (nobody ever believes just how much space a set of four timpani can take up) — hence the drums without bodies invented by Adolphe Sax. They save space because they can be placed overlapping each other, but they do not save weight. They are, incidentally, proof of the error constantly repeated in books that the timpani are the only drums which produce notes of definite pitch because of their closed shells. These drums produce perfectly good notes, just as do Rototoms, even though they have no shells. Most peo-

ple, even including the acousticians who say this, have cloth ears when it comes to dealing with percussion instruments.

Although Henry Wood imported the Pittrich drums, pedal timpani were not normally available in England until the 1950s except for light music and films — my Leedys came over with Paul Whiteman in 1929 and were used by light-music players until I bought them in 1957. Nowadays timpani are expected to be fully chromatic and they are seldom properly understood. One cannot tune unless one can hear what one is doing — Britten's *Nocturne* is the best example of how to write for timpani: one only has to tune while one is playing on it. Other composers expect one to be able to tune one drum while playing another, which can only be done by guesswork. Gauges are only approximate, and they need at least three eyes: one for the conductor, one for the music, and the third for the gauge; one does need at least a chance to look at the gauge.

By the middle of the nineteenth century, timpani sticks were changing. As we've already noted, wooden sticks were usual in the eighteenth century, and there is some evidence for cloth or thin leather covers for these at least by the end of that century, though there's very little precise information. Berlioz seems to have been the first composer with a keen enough ear to demand a precise quality of sound from his timpanist, and he often specifies the newly available baguettes d'éponge, a sponge-headed stick. Sponges come in a variety of species and thus of hardness, and there are several species which may well have been suitable for

this purpose. The main reason for his specification of these sticks would seem to have been that drum-skin had grown thinner and wooden sticks sounded bad on it. Here again, it is the result of improving technology. When skins are skived by hand, there is a limit to how thin one can get them, especially if they are to be even in thickness all over. This one can judge from examining mediæval manuscripts, where the vellum folios are seldom equal in thickness even on something the size of a book page; some pages are as thin as modern drum skin, or even thinner, but often the next page is more than twice as thick. With machine skiving, a much thinner skin became available, sufficiently thin that wooden sticks made a harsh rattle. Thus, to get a decent tone quality, a new stick material was needed, and players came up with natural sponge, which grows freely in the Mediterranean.

A similar situation has arisen today — plastic has replaced skin and the sticks which sounded well on calf-skin sound very poorly on plastic. Perception of tone quality is not as sharp as it used to be, and players are still using sticks suited to calf with a resultingly unpleasant tone quality — nobody seems to be experimenting to find a stick material which will produce a good tone.

Changing sticks in the mid-nineteenth century meant changing the playing technique. Wood sticks bounce easily, as one knows from the side drum, and this is why Beethoven and his contemporaries so frequently wrote double beating patterns such as rapid pairs of notes alternating on each drum, which are very easy

to play with two strokes from each hand but, because felt sticks and baguettes d'éponge don't bounce, are very much more difficult today, and single beating with tricky cross-action is nowadays necessary to play Beethoven parts.

The real expansion of military percussion came in the second half of the eighteenth century with the introduction of the Turkish music. This was often a matter of show. A band dressed up in pretty costumes makes a good impression, and if their instruments look impressive as well, all the better. So there was often a Jingling Johnnie, which was also called a Turkish Crescent, because it often had a crescent on the top after the Turkish model, or a Chapeau Chinois, because the top element was often shaped like a Chinese coolie's hat. This was thumped on the ground to give the beat, and all the little bells rattled. Berlioz scores it occasionally. The triangle still had the rings that it had in the Middle Ages and the Renaissance. The Long drum, as the bass drum was known because it was deeper than its diameter, was played with a ● • • • pattern of beats by using a solid wooden beater on the strong beats and a switch like a miniature besom or broom on the weak beats; this is why in reputable editions of the *Military Symphony, Seraglio*, etc., some notes in the bass drum part have their tails up and some down, to show which beats are stick and which switch. This was an imitation of a beater and a thin stick used on the Turkish davul. The side drum was used, of course, as was the tenor drum, though that, in the shape of a miniature timpanum, was a very different shape from the modern instrument

like a larger version of the side drum, which was introduced during the nineteenth century. Finally, there were the cymbals and often the tambourine.

In the orchestra, as we know from both the Haydns, Mozart, and Beethoven, the Turkish music was usually only the bass drum, triangle and cymbals, and all were lighter in sound than the equivalent modern instruments. The cymbals were smaller; the bass drum had much smaller diameter heads, and the triangle sound was more continuous with less tinkle than the modern instrument. As so often, the instruments came into the orchestra from the military and through the opera. During the nineteenth century, the cymbals and bass drum grew larger and heavier in sound, though the great Distin drum, some six feet wide, made for the 1857 Handel Commemoration was exceptional in this respect; the long drum retained its shape for normal use. The side drum shrank, however, first to the size still used in military bands, and then further still. The triangle lost its rings; exactly when we do not know, but certainly by the time that Liszt wrote his *E♭ Piano Concerto*.

With the rise of romantic music, musical scene-painting began, of which Beethoven's *Pastoral*, with its bird imitations in the slow movement and storm in the scherzo, is an early example. Berlioz and Meyerbeer demanded bells. Nowadays these are usually imitated with tubes, since true bells would take too much space on the platform or in the pit, and weigh tons rather than kilograms. The quarter bells of Big Ben weigh, according to Alan Phillips: just over a ton (1070 kg), over a ton and a quarter (1320

kg), over a ton and a half (1680 kg), and nearly four tons (4000 kg), and Big Ben itself, the hour bell, weighs just over 13½ tons (13,761 kg). The only way to get those pitches with real bells is to have those weights. Wagner had other ideas (to quote from Cecil Forsyth's description in his *Orchestration* of Felix Mottl's bell machine for *Parsifal*, which demands the 4-foot C in the bass clef and the G, A and E below it):

"The appearance of this machine is somewhat startling. It is as if an amateur carpenter had been trying to convert a billiard table into a grand pianoforte, and in the course of his experiments had left the works outside. There is a deep sounding-board over which are strung heavy pianoforte wires, six for each note required. In each of these sets of six three are tuned to the octave above. The strings are set in vibration by a broad flapper or hammer loosely covered with cotton wool. How little this sounds like a bell may be judged by the fact that at Bayreuth it was found necessary to employ at the same time four Gongs or Tam-tams, tuned to the pitch of the four notes. Even with this addition, the notes lacked the "ictus" (the tap) and the general buzz (the hum) of the real bells. A Bass-Tuba was therefore requisitioned and made to play [a semiquaver at the beginning of each note] while a continual roll was performed on a fifth Tam-tam. This instrument has apparently now [1914, or perhaps in the 2nd edition of 1935] been abandoned at Bayreuth in favour of a set of tubes" — Forsyth is always worth reading, both for entertainment and learning.

Saint-Saëns imitated the rattle of dry bones with the old four-row xylophone, which has nowadays changed radically in shape. This happened when the Mexican and Guatamalan instruments became known in the USA and Deagan of Chicago started to make instruments on their pattern, using, instead of their long single row of bars, the layout of the piano keyboard. The xylophone was joined by similar instruments in metal such as the glockenspiel (which Saint-Saëns referred to as harmonica, a memory of the glass harmonica which was followed by other glass instruments of xylophone shape — he did not mean a mouth-organ as was used in the Kostelanetz recording!), and the vibraphone, which has a revolving fan in the top of each resonator tube which, as it rotates, opens and closes the tube and so provides an amplitude vibrato. Tschaikowsky wrote his Danse Arabe with the tambourine. This word is a well-known trap. Tambour de Basque is the French for tambourine, whereas the tambourin, a deep tabor with a single snare, struck, like all tabors, with a single beater, is the Tambour de Provence; this is what Bizet asks for in *L'Arlésienne*. The two are sometimes confused by ignorant conductors. Rimsky-Korsakow wrote his *Capriccio Espagnol* with tambour de Basque, castanets, cymbals, bass drum, triangle, and side drum, and there are many more examples of such musical scene painting.

Some of these instruments were adopted into the orchestra, for example the tambourine, which simply became another orchestral percussion instruments, whereas others remained exot-

ica, for example the castanets, which, until very recently, always meant Ah! Spain. Playing techniques were Europeanised, and the tambourine was not played as it was in the Middle East. The castanets were not fixed on the thumbs, partly because the playing technique is difficult, but chiefly because percussion players have to put one instrument down and pick another one up with the minimum of time in which to do it. So orchestral castagnets with one shell on each side of a wooden plate on a handle, machine castagnets, tied down hard on a wooden board so that they can be tapped with sticks or the fingers, and various other models are used instead, often home-made, for percussion players have to be inventive.

In more recent times, far more exotic instruments have been imported from other lands. From Latin America we get bongos, maraccas, guiro, and a variety of other instruments. From China we get the Tam-tam, which is quite distinct from the gong. In orchestral parlance, the tam-tam produces a sound of indefinite pitch, a spreading crash, spreading because it gets louder after being struck, whereas the gong produces a note of definite pitch. Puccini, in *Turandot* was precise, and had a set of tuned gongs made for him. Later composers have been less sensible — what does "high / medium / low gong" mean? — all gongs are pitched — do they not worry about what pitch will be produced? What is more, all exotic gongs are pitched to notes within their own scales, which are quite different from ours.

Europeans are very deaf to percussion pitches. All drums are pitched, not just timpani. Kettle drums such as timpani may be more precisely pitched than others, but their overtones are still inharmonic, like those of any other drum. This is why in other, more sensitive cultures, tuning paste is used, for example on tabla and mrdangam. What about 'log-drums' — they are all pitched to their local scales. I played in the first performance of Roberto Gerhard's Symphony, and Gilbert Webster and Gerhard had spent a good deal of time at one of the big hire firms selecting all the Chinese temple blocks they wanted. At the first rehearsal, Roberto came up to me with what looked like a small brass ash-tray (a miniature Japanese gong) and said "that's what you hit at letter Q" or wherever it was. What happens at future performances? To my mind, this is an abnegation of responsibility. But maybe the composer really doesn't give a damn what his music sounds like. The same happens with aleatoric music. The result is that if the composer cannot be bothered to write what he wants the audience to hear, the audience, only too often, cannot be bothered to come and listen. Hence empty halls. Hence the early music revival, which we started back in the late 1950s with Musica Reservata; we regularly sold out the Queen Elizabeth Hall with mediæval music because this was something that the musical public could adhere to, whereas modern music was being played to a three-quarter empty Festival Hall next door. This is the first generation of music-listeners that did not eagerly await the lat-

est work of major composers, and it marks the end of musical appreciation by the public — the tragedy of our time.

So where does all this link with our main subject, the Industrial Revolution? Much has been implicit, the new technologies required to produce the mechanisms and materials that I've referred to all the way along, the opening up of the rest of the world which made so many exotic instruments familiar to us, as well as producing the new materials which we covered several sessions ago. The percussion came into the orchestra often for the sake of novelty, to titillate the wider public who were acquiring the taste for music, and also in the usual endeavour, so often referred to, to make more noise in the bigger halls. The sound of the percussion had become familiar with the military bands and the public bands, and these, and their spread, are the subject of our final session next week.

12 Bands, Choirs, and Factories

The military band was a creation of the latter part of the eighteenth century. Before that time the army had marched to fifes and drums, and battle signals were given by trumpet, bugle, and drum, much as can be heard in Beethoven's worst symphony, *Wellington's Sieg oder die Schlacht bei Vittoria*, better known, perhaps, as *The Battle Symphony*. This was originally written for a large size musical box or barrel organ which Mälzel, who had also stolen someone else's idea for the metronome, was trying to make his fortune with. With the Turkish invasion of Eastern Europe, culminating in the siege of Vienna, imitation Turkish bands became popular and fashionable, with the percussion instruments familiar to us from Haydn's *Military Symphony*, Mozart's *Il Seraglio*, Michael Haydn's *Turkish Suite*, Beethoven's *Ninth Symphony*, all of which we discussed last week, and, when you have an instrument provided with the right gadgets, from a good deal of piano music as well, of which Mozart's *Rondo alla Turca* is by no means the only example. Leaving aside the occasional use of trumpet and serpent, the other instruments of this band were usually pairs of oboes, clarinets, horns, and bassoons, the standard *Harmonie Musik* of the classical and early nineteenth-century wind octet.

With the invention of various devices for allowing brass instruments to play chromatically, or anyway diatonically, in the lower parts of the register (playing diatonically in the upper register had died out at the end of the Baroque with the break-up

of the Trumpet Guilds), more brass instruments rapidly became standard instruments in the military band, if only because they made more noise than woodwinds, something which is always useful out of doors, and because they did not depend on such fragile elements as reeds. The first was the serpent, as we have already mentioned, which had fingerholes and was thus not wholly dependent on the harmonic series for its range of available notes. It was made in a variety of shapes, not only in the basic serpentine sinuous form. The Napoleonic wars led to a rapid increase in the size of the armies of many nations, followed by increased demand for military instruments, and, as you'll realise if you ever try to march carrying a serpent, a strong demand for more portable varieties. The demand was met by bass horns, serpents Forveille, Frichot's upright serpent, all of which can be seen in the Bate Collection, and several other varieties also.

Recapitulating further, next came the key bugle, invented by Joseph Haliday, an Irish bandmaster, in 1805. This invention was taken up by a number of continental makers, the most important of whom was Jean Hilaire Asté who worked under the name of Halari and who invented a whole family of key bugles, the bass of which he called the ophiclé ïde, French-Greek for keyed serpent. Ophicleides, as they were called in English, remained standard band instruments, and also orchestral instruments, well into the middle of the 19th century.

When the valve was invented, in 1815, it was soon applied to a variety of short brass instruments (by short I mean a tube-length

of a metre or a metre and a half) such as posthorns and bugles. The cornet de poste became the cornet à pistons, cornopean and later cornet in English, and the bugle, the standard infantry instrument (only the cavalry were grand enough to have trumpets), became the flugel horn.

These instruments, cornet or bugles in the treble and serpents and ophicleides in the bass, transformed the military band, but left it with a very hollow middle. This middle was filled by the creation of a family of each type; alto and tenor instruments of either cornet or bugle bore. This was followed by bass instruments such as the tuba. Most of these developments took place in Germany where the idea of musical instrument factories seems to have first taken root. Both the idea and the instruments spread quickly, of course, with makers such as Adolphe Sax in Paris pirating many of these designs, as did Distin, his main agent in London, who not only imported Sax instruments but started making very similar instruments here in a factory which was eventually taken over by Hawkes, now Boosey & Hawkes, who have mainly reverted to Distin's original practice of importing instruments and putting their own name on them.

The whole idea of a factory was, of course, a product of the Industrial Revolution; in fact, before that period, what was meant by the word factory was a store or warehouse where a factor, what today we would probably call an import/export agent, kept his wares. There were, of course, workshops where instrument makers made their instruments. While sometimes these were one

man and his lathe or whatever other tools, they were quite often considerably larger establishments with the master, two or three assistants, and probably an apprentice or three. I have a strong suspicion that something very like the assembly line was already in existence; that rather than one chap chopping a piece of wood and seeing the instrument right through from that to the finished article, that one man did one job, passed it on to the next who did something else, and so on through the shop. Certainly nobody but an idiot worked on one instrument at a time. Whatever type of instrument one was making, it was always quicker and easier to do at least some of the work in batches, so that Strad would have half a dozen fiddles all at much the same stage of production, Stanesby a dozen flutes, half a dozen oboes, and so on, Ruckers quite possibly two or three harpsichords, though space becomes a problem there, and Raoux a couple of dozen F crooks.

There has also almost certainly always been some outwork. There are places today where you can get keyboards cut out; you mark the plank and send it off to be cut. Certainly there have always been specialists making woodwind keys in London; Maurice Byrne has produced several articles on makers' marks on the undersides of keys, and I've taken a number of detail photographs here for him. John Hale was a woodwind maker, to some small extent, but he also made keys for everyone else, stamping them IH. The Dutch are pretty sure that they know who engraved the silver keys for Richters's oboe; he had a silversmith in the family. What we don't know is who had the very elaborate rose en-

gine lathe with which the ivory was decorated; it may have been Richters himself, but it may not have been. Two of our baroque recorders are externally so similar that I am convinced that there was a recorder workshop turning out blanks with a pilot bore, which they then sent out to the trade. One of ours was finished by Bressan in London, and the other by Urquhart, who was almost certainly Scots, though we don't know whether he worked in Scotland or whether he was also working in London, and the finished bores, and thus the tone quality, are very different indeed. It may, of course, have been Bressan himself, or his lathe man, who made them; it would only have been an arrangement like the modern practice of selling instrument kits!

Equally, there has always been at least some machinery. You don't get brass tubing through lead blocks just by poking at it, nor can you draw wire down for strings through a steel die between finger and thumb. Hammer mills, windlasses, sometimes muscle powered and sometimes water powered were with us for a long time before steam power came in. But once steam was available, then far more powerful machines became available and, with belts and pulleys, it was possible to link machines up, much as is done with electric power today. Then you could have a row of machines all doing the same job, and a row of workmen who were responsible for just sawing, or drilling, or polishing, or whatever. Sax's shop in Paris seems to have been very much like this, judging from surviving photographs, and so was Higham's in Manchester and some other big manufacturers, though there were still

plenty of small shops, with just the master and two or three assistants and an apprentice or three, or even the one chap with his lathe or whatever. The same is still true today, though there are fewer of the single craftsmen except in the early music world, where almost all are small workers.

Even the bigger factories were far more relaxed up the end of the 1930s than they are today. Rudall Carte would make you any variant of flute system that you asked for and were willing to pay for; we have plenty of examples here of one-off systems or of special orders for a special, but not often asked-for, system. Even Boosey or Hawkes would produce a special model to order, like the valve F bass trombone here, and so would any of the Continental shops. That is one of the differences from today, for I rather doubt whether Yamaha, for example, would add special keys for you. Once you computerise and fully mechanise, it's much more difficult to produce variants in ones or twos. This is something that people are better at than machines. But machines are cheaper, and they don't go sick or want holidays, nor for that matter do they sleep.

Musical instrument factories, even at their biggest, never compared with places like cotton mills, steel mills, coal mines and so forth, which, in the early days of the Industrial Revolution had an insatiable demand for workers. Because the factories and mines tended to be clumped geographically, they were also inevitably competing with each other for workers. One way of attracting them was by encouraging outside activities, and there are many

examples known of a factory advertising for a craftsman with a certain skill who also played a certain band instrument. The mill band, Black Dykes Mill, for example, or Foden Motors, or the mine band, became well established in the nineteenth century, and many still survive today.

Bands in England became quite rigidly formalised. They started, of course, with whatever was to hand, but there grew up a strong competition movement, not altogether surprisingly; the idea of 'my lot's better than your lot', whatever the lot may be, is pretty well engrained in human nature. Competitions between widely differing ensembles are difficult, and almost impossible, to adjudicate fairly. And so they became formalised. There were basically two varieties: the military band and, once the valved brass were invented and established and available reasonably cheaply, that is to say factory-made, the brass band.

The early military band in Britain was the personal property of the Colonel of the Regiment, or when he was too poor or too unmusical, it was established by the Officers clubbing together to pay for it. The War Office had some say in what numbers and what instruments were permitted, but they made no financial allocation for it, and thus the players were paid, their instruments provided, and their uniforms paid for, by the Colonel or other Officers. With the rapid expansion of the army to fight Napoleon, bands proliferated, and perhaps more important was the contemporary version of the Territorials, the local militias which were mainly amateur soldiers formed into regiments in case of inva-

sion. Here again the Colonels and other officers were determined that their regiments would be as smart as the main army, and smarter than the neighbouring militia, for these were all very local with strong local rivalries, and one way of achieving this was by having a smartly uniformed and musically competent band. The simplest band was the fifes and the drums, and these still survive with Boys' Brigades, Scouts, and similar organisations, and there is still a reasonable amount of amateur flute bands around, especially in Northern Ireland where they are a very strong movement. More complex were the wind octets, already referred to, and more complex still those with the new fingerhole brass instruments, key bugles, bass horns, ophicleides and so on, and later on those with the valved brass such as cornets and the other instruments of that ilk.

When the wars ended in 1815, and the regiments disbanded, there was thus a large pool of trained army musicians thrown on to civvy street, and the same thing happened after the Crimean War. The situation must have been very similar to when the talkies came in; every cinema in the country sacked its orchestra and there were thousands of musicians thrown out of work. These men took work wherever they could find it, and where possible took advantage of their skill as musicians to get into a good firm which also sponsored a band. Where there was no works band, sometimes there was a municipal band, though once the Police force was established, they have always been organised in a very similar way to the military and often had their own bands which

would play for the municipality. The municipal band, of course, goes right back to the Middle Ages. The Town Waits, in Germany the Stadtpfeiffer, were an essential body, for not only did they provide the music for celebrations and social occasions, but they were also the town watchmen. There are still survivals of this in England, for example the Ripon Horn Blower. Once people thought of sticking up a band stand in the town park, these bands provided regular concerts, and this was often the only place that people heard music other than in the church and at dances. While, as I said, the Police could sometimes provide such a band, they could not always be counted on, for their players were policemen first and bandsmen second. So any go-ahead municipality would either provide the opportunity for a municipal band, at least paying for their uniforms and, with, luck, their instruments, or would encourage the formation of local amateur bands.

Much of this still goes on, and the military band, the band of mixed woodwind and brass instruments, has grown to become the modern concert band. This, to a great extent, was due to Sousa and to his successors such as Goldman who ran famous concert bands. They were the inspiration for the American High School and College bands, and an enormous repertoire of music grew up for them. The concert band, or symphonic band as it is also sometimes known, is now a world-wide activity, with its own international association, journals, competitions, festivals, and so on.

The other main variety of band, the brass band, was also stabilised by the competitions which were held at Belle Vue in Manchester and The Crystal Palace in London. The instrumentation became fixed, with cornets and saxhorns, plus trombones and percussion. The Salvation Army movement was equally as important as the works bands in the spread of the brass band. Booth wanted to take religion to where people were, and the most obvious place was the street corner, and the most obvious accompaniment for hymns on the street corner was the brass band. Eventually they wound up with their own school of music, just as the army did, with Kneller Hall, and the Marines at Deal, and their own factory in Judd Street, where instruments were made to their own specification.

On the Continent, bands, especially municipal bands and amateur bands, were much less rigidly fixed in their instrumentation, and tended to be a more heterogeneous amalgam of woodwind and valved brass. One has the impression, too, from photographs, that the earlier American army bands, say of Civil War vintage, tended to be a fairly mixed lot, though I have the impression that today they are a fairly uniform mix, based on Sousa's and Goldman's bands.

The only problem with the band movement is that it does require some skills, some dexterity of finger, and a good deal of practice. Also, at least until recently, it was pretty sexist. I can't remember any nineteenth-century photographs which showed both men and women in the same band, nor were women's bands com-

mon, if they existed at all. And yet the factories and mills employed as many women as men. Was there no musical future for these women? There was, of course, and this was the mainspring of the choral societies. The nucleus of these was often the chapel, especially in the smaller towns and villages. Perhaps also such great choirs as the Huddersfield Choral Society may have started by getting a number of smaller chapel choirs together for a festival performance. Many of these choral societies have become world famous, and even today, despite the early music movement, there are still performances of *Messiah* with choirs of a thousand voices. This has also become an international movement, with amateur choral societies tied to a locality, to a church (the Mormon choir from Salt Lake City is world famous) or to an orchestra, for all the great orchestras have formed their own choirs for the performance of the major choral works, and none of them can afford to run them as professional organisations. Even the BBC, while it has the professional BBC Singers, a small élite group, also has the amateur BBC Choral Society.

The church and chapel choir did not, of course, sing unaccompanied when working at home. Sometimes they had a harmonium, or maybe a barrel organ, instruments that we saw way back in this series, but often they had the church band. This became a necessity when the metrical psalter gave way to the hymn book, for in many English churches the organs which had been used from quite early times were destroyed in puritan zeal in the Tudor period and under the Commonwealth. The church band

was the most heterogeneous of all bands, for the instrumentation depended entirely on what the players could get hold of and could get their fingers round. It was mainly a village institution in Britain, for a town church could normally afford a new organ of some sort. Fairly constant members were a clarinet, maybe a flute, a bassoon, and a string bass, either a double bass or more often a 'cello. Frequent additions were a serpent, an instrument which had started out as a church instrument in France, and a fiddle, for most places also had some sort of dance band, of which the fiddle was of course the leader.

Such bands were different in Germany, where the Lutheran tradition ran to brass choirs, usually a group of trombones, the lineal descendants of the standard accompaniment to voices in church. These can still often be heard, and there is a fair corpus of music published for them.

We must not forget the regional band, the band which plays the local folk instruments. Sometimes this is a fairly bogus affair, as when you hear a dozen alphorns all playing together, a folklorist movement rather than a genuine folk one, for the alphorn is essentially a solo instrument, played by one man on an alp to his fellow on another. Often though, it is the genuine folk band of the region, like the Hungarian and Romanian gypsy bands, the Highland bagpipes and drums, the Tyrolean band of fiddle and dulcimer and squeeze box. Nor must we forget the like-instrument bands, where enthusiasts for a certain instrument get together to play in accordian orchestras, mandolin orchestras, harmonica or-

chestras, and a plethora of others. These two, the regional and the like-instrument bands, have coalesced in one area as a political statement. It is not kulturny to play by oneself, and as a result in the USSR, where many regional instruments were used alone in the genuine folk tradition, bands have been formed, and new instruments developed, so that one now has a whole family of balalaikas, domras, or whatever else, all playing together under a conductor, and this idea has spread, partly with Marxism, to many other countries. The 'Folk Orchestra', which often goes on international tours to boost the prestige of the home country, or boost the sales of its exports, is a modern and wholly bogus affair, with the minimum of genuine 'folk' about it.

An unfortunate by-product of the Industrial Revolution was the recurrent slump, when many thousands were put out of work, and the great slump of the 1920s and 30s was compounded by the end of the First World War, with armies demobilised with no work to go to. Many groups of ex-servicemen formed casual street bands, like the church bands using whatever instruments they could get hold of and play, with the less musical or physically incapacitated members rattling collecting boxes. Groups of jobless men, especially those on the so-called hunger marches, formed kazoo bands, for the kazoo can be quite easily made, whether it is just a comb and paper or a tube of any material with a piece of thin paper or onion skin tied over one end, which is played by singing or humming into the other end. Such a band

was probably more interesting in sound, and perhaps less tiring, than just singing.

Similar urban bands existed elsewhere, of course. Sometimes they were functional, getting together for a specific purpose, just as the early jazz bands seem to have grown out of funeral processions, as well as existing just for fun. Similarly, the West Indian steel bands were initially formed for carnivals and similar occasions. These are perhaps the prime examples of the effect of the Industrial Revolution on music, for the instruments are made of the waste products of our industrial society. Initially the instruments were the brake drums, springs, and other parts of scrapped motor vehicles. Probably by chance, it was found that a formed piece of metal would produce a different pitch on a dented area, where the metal had been deformed, stressed, and hardened. The tops of old 40-gallon oil drums were found to produce the best tone quality, and by forging, hammer-forming under heat, separate areas on the top of each drum, and by isolating those areas with punched lines, it was found that whole groups of intentional dents could be formed on one drum top. The size of the area, and the extent to which it is dented, controls the pitch, and thus sets of pans were made, the smallest, the ping-pong, with twenty or more areas, down to the bass with only two. For the best sound, the depth of the barrel was also important, so that a bass would be almost the whole depth, with just the last couple of inches sawn off, that part becoming the ping-pong, the tenors with rather less depth, the cut-off part becoming the second pan, and the altos

being each half an oil drum. Tuning a steel drum is a very noisy operation; one wangs each area up with a ball-pein hammer, increasing the height of the dome to sharpen the pitch, and bashing it down to flatten it. The beaters vary, of course, according to the size of the drum, the highest being bits of bamboo or stick with rubber bands wrapped round them (easily accumulated in Britain by following a postman in his rounds), the larger ones being whole or half rubber balls spiked on a stick.

Today, there are professional makers, both in the West Indies and abroad, producing pans of superior quality, but there are still a number of bands, working in the old way by scavenging dumps for old oil drums, the instruments being made from the waste products of the Industrial Revolution, the makers trained in metal work by their Industrial experience, and the players, only too often those thrown out of work by the increasing industrialisation of our mechanised factories.