Reinventing the Oboe: Responding to Technical Challenges, Creating New Horizons[1]

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Before focusing upon re-design work for the new instrument, some observations of a general nature and a brief overview of the historic development of the instrument are offered as a background to the presentation.

In redesigning the key-work of the oboe as part of the *21st Century Oboe* project two aims have informed the focus of the work: to render some of the most demanding music written in recent years more playable and to expand the potential of the instrument.

Two decisions were taken very early on in the project:

1. To make the instrument out of cocobolo wood.
2. To build upon what already exists rather than re-designing from scratch.

At the beginning of the research project I spent some time experimenting with instruments made of cocobolo wood. Cocobolo wood is not as heavy and is slightly more resonant than traditional African black wood. I was aware that I would be adding more key-work to the instrument and that this would make it considerably heavier, cocobolo offered an interesting alternative. As the modern oboe is already rather heavy it can cause physical problems for some performers and therefore any option that could help reduce weight was to be welcomed. In fact the new instrument, made of cocobolo is the same weight as the standard African black wood Howarth XL oboe.

The re-designed instrument is a high level professional instrument, specifically developed for the performance of contemporary music and as such has been designed with the professional in mind. The emphasis upon the professional, and explicitly the performer of contemporary music, was a significant factor in the approach to the redesign. To rethink the key-work from scratch (a strong case could, arguably, be made for such an approach) was considered but rejected. Such an approach would be unlikely to meet with much enthusiasm from the professional sector simply because of the time required to master such an instrument in the context of a busy professional schedule. The decision was therefore made to modify the instrument, retaining almost all of the current key-work while making minor modifications and adding new developments where necessary. Such an approach is in keeping with the19th century approach to oboe development that led to the oboe as it is known today.
Any professional performer can therefore use the re-designed instrument, as the standard key-work still remains and the re-design changes can be studied as required.

The research has involved a number of different approaches including empirical, theoretical and creative research. Each of these approaches has at some point involved me in collaborative work with composers, instrument makers, other performers, musicologists and scientists.

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[1] In order to avoid clumsy and complex descriptive passages when writing about the key-work of the oboe I have added an annotated picture of a standard conservatoire oboe at the end of this document.

Unlike the flute with its carefully developed and well reasoned Boehm system, the key-work of the oboe developed in a much more ad hoc way, (the Boehm system was applied to the oboe but it was fraught with problems, had few adherents and was never accepted in the oboe world).
Nineteenth-century makers left little documentation of their procedures, processes or methods of instrument development and so much of the work I undertook started by developing foundational principles. When beginning this work I asked some oboe makers what instruction manuals they used when handing on their knowledge – the answer was 'none, it is all word of mouth and live demonstration!'

An Historic Perspective (slide two):

The history of the oboe can be divided up into several periods. These are of course generalizations but they are helpful in understanding changes the instrument has gone through.

After the early days of the development of the instrument, the 18th century was a period of stasis. During the 19th century however the instrument changed considerably; it went from being a two keyed boxwood instrument to an instrument made of hard wood with a considerable number of mechanical keys. By the end of the 19th century the modern oboe had come into existence. The 20th century was again a period of relative stasis when only minor changes were made.

During the second half of the 20th century however there were some major developments in the area of performance practice. These developments have gone hand in hand with the rise of solo performers such as Holliger. The changes have affected both the sonic world of the instrument and the techniques performers are now expected to develop. As a student I was firmly told by my teachers that double, triple and flutter tonguing were not possible on the instrument. Now many of the pieces I perform use these techniques as a regular part of the performer's techniques. It is perhaps not surprising then that such developments in performance practice should at some point begin to ask more from the instrument itself. Such technical demands did not arrive fully-fledged over night but grew over a number of years. The use or range is a case in point; the Zimmerman Concerto (1952) uses an A_6 but this is carefully placed and the performer moves chromatically up to it. By the mid 1960's Castiglioni wrote up to B_6 in his solo work *Alef* ; once again the performer moves carefully up to this pitch. By 1969 Takahashi had written a $C\#_7$ and in a much more demanding context. By the 1980s the more adventurous composers were using a extended range including C_7 almost as though it were a normal part of the instrument's range. Roger Redgate's *Ausgangspunkte* is a case in point.

Significant areas of challenge: Examples from Ausgangspunkte (slide three).

A brief excerpt from Roger Redgate's *Ausgangspunkte* (1980-81) will give an idea of the scope of the challenges to the contemporary performer (slide three). (Many other works could be cited at this point including works by Finnissy, Ferneyhough, Archbold, Gorton and Barrett).

[Extract performed live from pages 8 and 9 of the work.]

In these two pages, ignoring the staggering challenges of the complex rhythmic work, there are examples of many of the technical demands being made of the performer today. As has been noted above, the pages include considerable use of the extended range. Though not on these two pages, the work does ask for a D_7 ¼ tone sharp, (the first example in the repertoire). There are many multiphonics present in the work including, at the climax (page 9), a complex trill requiring five separate trilling actions, each one working independently of the others. Additionally ¼ tones are used throughout the work as a part of the compositional language. Many of these resources are used at great speed and often in conjunction with others. It is a radical rethinking of the oboe's sound-world and capabilities.

These changes to performance practice can be divided into two categories. There are those that are primarily *sonic* resources such as multiphonics and others that are *techniques* such as flutter tonguing or circular breathing. Some therefore make physical, technical demands on the performer while others, at least in their pure form, are simply sound resources.

The demands that a work such as *Ausgangspunkte* makes take not only the performer to extreme limits but also asks a great deal of the instrument itself. It is not a case that the instrument mechanically cannot cope or that it may collapse under the strain but rather that the complex use of the resources and techniques highlights the limitations of the design of the key-work. These problems were a major motivating force behind the decision to rethink the instrument's key-work.
It is important to stress here that the composers who have explored this territory are very well informed as to the instrument's capabilities; these are not in any way misjudgments on their part. Many of the works have been written with significant levels of collaboration between composer and performer. What is taking place is more akin to an evolutionary process in the development of the instrument as small ideas have developed and solutions have been found. My own approach to this work has always been to try to find solutions to the problems or at least to find a presentable performing version while always striving for better options. As a performer I welcome these challenges and changes as a major part of the future of the instrument.
It has now reached a point where the key-work of the instrument is out of date.

Implications for key-work development (slide four)

The brief discussion of *Ausgangspunkte* above highlights three areas where the demands on the key-work become quite significant; altissimo range fingerings, multiphonics and microtones. In terms of key-work use there is a great deal of crossover and the problems raised cannot be solved independently.

One of the most significant areas of crossover between all three of these areas is in the use of the left hand side trill keys, [indicated on the photograph at the end of this presentation as c# and d trill keys]. These trill keys were designed to trill c-c# and c-d in the middle and upper register; they were never intended for more extensive use. However they are used extensively as part of many microtone, altissimo range and multiphonic fingerings. The problem for the performer is that the use of the keys in these contexts demands unorthodox hand positions as the fingerings that operate them must also be used for other key-work at the same time. Such usage causes the hand to be twisted into unusual positions, causing limits on accuracy, speed of execution and even, in some cases, rendering a passage unplayable. A re-positioning of these keys could remove this set of problems.

The altissimo range could also be improved by the development of vent keys that could make the response easier in that range.
Microtonal performance could be enhanced by re-tuning some of the small holes on the instrument and by releasing or removing some of the links at the bottom of the instrument.

Research work:

1. Exploring the Altissimo Range and the search for a fourth octave key position.

Exploring the extended range has been approached from different angles.

- Staple research and venting options
- Fingering research

Staple research and venting options – the search for a fourth octave key

Three staples (slide six) were produced each with three vent holes of different sizes and positions along the tube. Empirical work was carried out on these staples by testing every hole with every fingering on the instrument. Each test was repeated on three different reeds. A detailed spreadsheet was produced. This area of research, while not revealing what we were looking for, (a position for a fourth octave key) did point to other areas of possible development beyond the scope of the current research remit.

A second approach was to explore a range of octave key options and aperture sizes on the body of the instrument [slide 8]. The six positions were chosen because of their acoustic potential and had a range of octave cups inserted into them with different hole sizes (ranging from 0.06 mm through to 2.3 mm [the standard size is 0.75]). It was possible therefore to test not only the position of the holes but also their response using the different sized holes. Every hole position using each of the hole sizes was tested using the standard fingering combinations from B_3 to C_7. Each of these tests was repeated using three different reeds. The information was collated in a spreadsheet, and then for ease of reference for the makers, the sheet was colour coded using red (none or very poor response), yellow (works but results not ideal) and green (a good response). Slide 9 offers a section of the coloured spreadsheet. This research highlighted some very interesting areas for future development of the instrument but did not produce what we were looking for. We did however find one area of the instrument that had potential for other areas of development.

The use of impedance testing was very helpful in a number of areas of the research. This was carried out by Dr. David Sharp and Dr. Adrien Mamou-Mani of the Open University; thanks are due to them for the use of the impedance curves in the PowerPoint presentation. The tests used for the impedance curves use the fingerings only and therefore remove any influence from the reed or the performer thus giving an accurate and in-depth understanding of what a fingering should produce (Slides 10, 12, 13, 14).

Fingering research

In preparing for high range work on the new instrument I was aware that my fingerings for the altissimo range[2] may not work on the new instrument. I was also aware that the development of this high range has been even more arbitrary than other areas of the instrument's development. There are no recognized processes or stated procedures for the exploration of this range. I decided that I needed to try to develop procedures and guidelines both for my own future work on the instrument and for the standard instrument.
I therefore collected every fingering I could find for the pitches from $F\#_6$ to D_7[3] (just under 200 fingerings). I made a comparative study of each of these fingering sets and eventually dropped the $F\#_6$ fingerings, working instead from G_6.
A significant problem became evident in this research: some oboists and some schools of playing use the teeth on the reed in order to obtain some of the highest pitches, usually from Bb_6 upwards. This practice tends to lift the pitch of a fingering by about a semitone.
As I made a comparative study of the fingerings, looking specifically for general principles, I noticed that in many of the cases the fingerings offered gave no advice about use or otherwise of the teeth.
From the comparative work I was able to develop a range of 'generic fingerings' which I could use as a basis for altissimo range fingering research. In addition to developing these fingerings I also explored every possible modification of the generic fingerings and was therefore able to produce some guidelines for modifications that could help with intonation, response and microtones.
Slides 12, 13 and 14 show impedance charts for some of these fingerings:

- Slide 12 demonstrates the impedance results for the fingerings for A_6 - my 'standard fingering' and three generic fingerings.
- Slide 13 demonstrates the results of three fingerings for C_7. Slide 14 includes one of these new fingerings plus the generic fingerings developed as a result of the research.
- Slide 14 demonstrates the fingering that would be used with the teeth in comparison with three fingerings using different methods of venting.

Slide 15 is a section from a spreadsheet showing the various modifications that can be made to a generic fingering and the resultant changes to pitch or response.

Key-work re-design

I mentioned above the trill keys and the problems generated by their use in a wide range of fingerings. These keys offer a useful case study of the kind of developments that we have applied to the re-designed oboe. The tone-holes of these keys are located very close together towards the top of the instrument, very close to some of the areas offering positive results from the fourth octave key research. It was possible therefore that a third tone hole could be a great asset in this area as a high range vent hole. There were two issues to address in developing these keys; the positioning of alternative touch pieces for easier manipulation and the placing of a third tone hole. This latter was very challenging in that the wood in this area is very vulnerable and so drilling a third hole was not welcomed by the makers.

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[2] I define the altissimo range on the oboe as being $G_6 – C_7$. i.e. the part of the range that is above the suggested range in many orchestration books.

[3] For D_7 I still only have my own fingering.

Slide 16, is a photograph of our first attempt to find a duplicate placing for these keys. At the lower right one of the traditional trill keys can be seen, while the gold coloured keys are the duplicate trill keys. The 2nd octave key has been modified in order to make room for the new keys.
We came up with a novel solution to the third tone hole problem: three holes on top of each other! This became known as the 'hamburger key'. Slides 17 - 22 demonstrate the three layers of this key, and in slide 22, the three touch pieces beside the 2nd octave key. We have had to modify the 2nd octave key twice in order to get it just right and have experimented with the tension of the springs for the hamburger key.

Other modifications include changes to the key-work normally used by the side of the right hand (slides 23 and 24 - it should be noted that at this stage there are no pads on the instrument). Traditionally there are two keys here; a doubled G# key and a g#-a trill key. This second key is of limited value and, as I wanted to add other keys in this area I removed it. On the redesigned instrument there are three keys; the duplicate G# trill key, a side Bb key and a B ¼ sharp key. The Bb side key is one of two keys which I have had added to the instrument that can be found on some historic models. (This key was a part of the traditional English thumb-plate system and is frequently to be found of German system oboes.) The side Bb key has added to the instrument a significant number of multiphonics. One further key which is occasionally seen on modern instruments is the 'long C#', which I have included (this can be seen in slide 27).

Microtonal Work

Because I am interested in developing the musical landscape I have been working on a number of different microtonal options: ¼ 1/8, 1/3 and 1/6 tones as well as microtonal inflections.
Rather than simply trying to develop a quarter-tone facility (quarter-tones are the most used microtonal division in the contemporary repertoire) I decided upon an approach that would offer quarter-tones but with options for other microtonal potential. As well as the use of trill keys as discussed above I de-linked some of the traditional key-work which then offered an increased range of modifier keys, re-tuned some of the holes in the touch pieces in order to create quarter-tones and developed a split F# key that could produce an F3/4# and maintain the full range of double trills available (simply drilling a hole in this key would have lost these) (see slide 27) which also includes an enlarged hole in the e key which enables the performer to execute an e¼#.

Multiphonic Development

The LH1 key is a very special key on an oboe, and by regulating its distance from the tone hole it is possible to increase the number of multiphonics available. This has sometimes been done by unscrewing half a turn the regulating key which, given the size of the regulating screw, is very challenging to do when nervous in a concert! As part of the re-design of the instrument we have developed a screw mechanism that can be turned very quickly and which achieves the correct results. This can be seen in slide 29 where a computer rendition of the key is shown along with its sighting on the instrument.
As with the microtonal pitches the de-linking of some of the lower keys has increased the number of multiphonics available, as have the opening up of the low E key and the addition of both the long C# the side Bb keys.

On my standard oboe I have catalogued approximately 900 multiphonics. On the new oboe there is an increase of at least three times that number; I am still exploring all of the possibilities.

One other small but significant change is in the sighting of the 3rd octave key which has been relocated on the opposite side of the first octave key. This is an ergonomic change. In the traditional position the performer has to squeeze or pinch in order to apply the pressure needed to use the key. For traditional music where this key is used infrequently this is not a problem, but in music where the upper range is used frequently this key plays an important role. In the redesign the performer rolls the thumb, a much more natural activity and one which enables greater speed in this register.

The key-work developments can be seen as a starting point. They have met the original aim of rendering some of the technical challenges easier to execute and have opened up the possibility of a large increase in sonic repertoire, much of which remains to be explored.

Testing the New Instrument and Collaborative Work with Composers

I began working on the new instrument in short bursts. Any new woodwind instrument needs to be ‘blown-in’ slowly and so, to begin with, I was very limited as to how much I could do on the instrument. My blowing-in sessions were used in order to familiarize myself with the new instrument and with the additional key-work. I have since then continued to experiment and to research in systematic ways the multiphonic, microtonal and range potential of the instrument. Work with composers has proved to be very useful in the exploration process and they have asked me to research specific areas and to generate lists of fingerings, recordings of sounds etc. As a result of this work the new instrument has undergone some minor key-work changes and has been slightly re-tuned in a couple of strategic places. Much of the sonic resource research, in addition to having the systematic work mentioned above, has also been informed by extensive work in improvisation as I have explored the options and possibilities available.

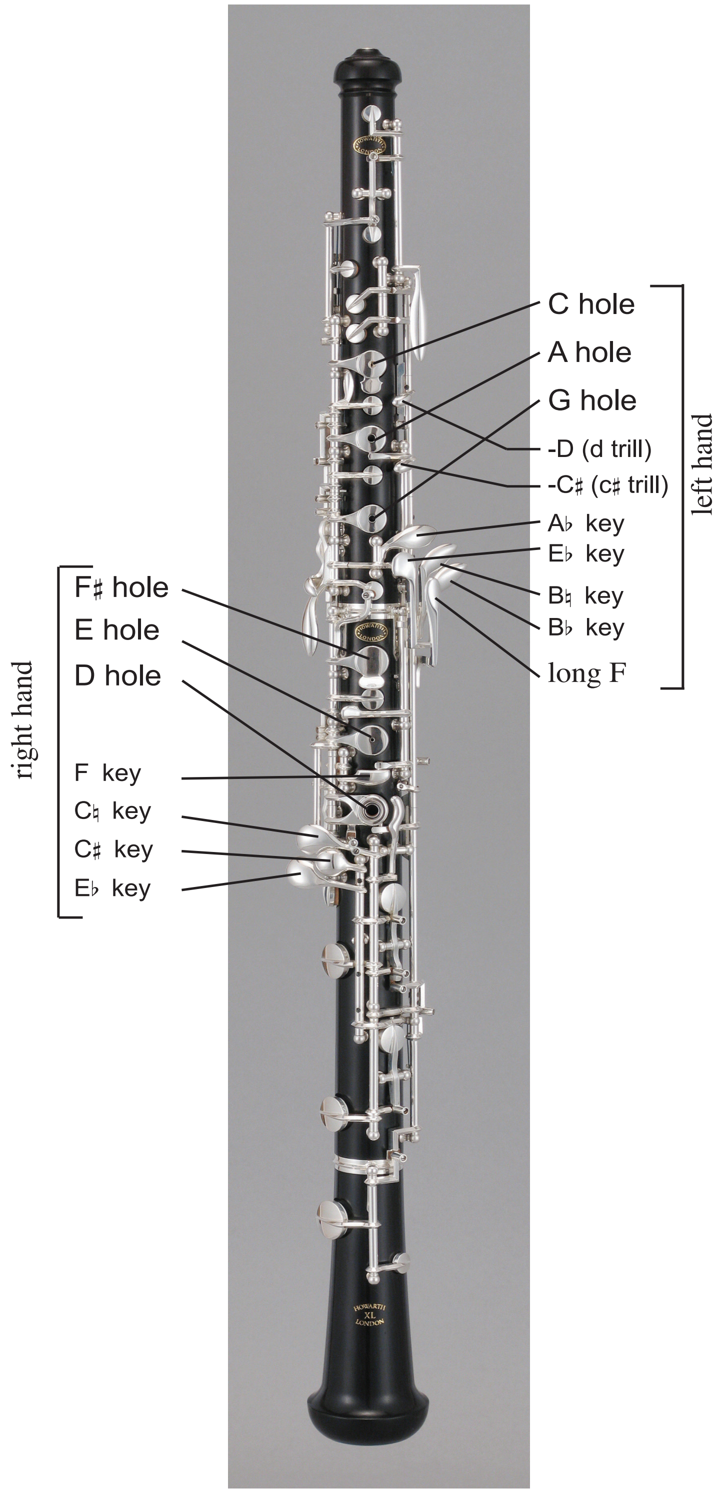

Photo courtesy of Howarth of London. Annotated by Dr. Paul Archbold.