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COPIES OF HISTORIC MUSICAL INSTRUMENTS

CONTENTS

Foreword

Arnold Myers, Vice-President, CIMCIM, Edinburgh

The most vexed question in collections of historic musical instruments is the extent to which the instruments should actually be used for their original purpose, making music. If they are not played at all, much of the benefit of preserving them remains unrealised; if they are played, the necessary prior restoration and the very act of use imposes loads and risks that are generally not compatible with proper standards of conservation. A playing regime for an instrument is not sustainable. The policy of most specialist museums of instruments has been to encourage the copying by appropriately skilled makers of instruments in their collections, in the hope that the copies will give a useful representation of the acoustical and performance characteristics of the original instrument, with the advantage that it can be subjected to the demands of practice and public performance. Yet there is widespread doubt about the success, and even the museological validity, of the copying process.

In July 1993, the CIMCIM committee meeting in Antwerp included papers invited from members on the theme 'Copies of instruments with museum value'. The aim was to bring together members' experiences with copies of museum instruments and to explore the philosophical and technical problems of copying. The meeting was organised by Jeannine Lambrechts-Douillez, past-President of CIMCIM.

CIMCIM is publishing nine of the papers presented, together with the organiser's introduction, as a contribution to good museum practice, not only in members' museums, but also in other museums where there may be only one or two musical instruments and no specialist curator.

Introduction

Jeannine Lambrechts-Douillez, Antwerp

The main aims in building copies can be (a) to provide good instruments that serve music as it was written by composers, without transcription or adaptation to more recent instruments, and (b) to add to our knowledge of the construction of original instruments. CIMCIM has discussed the problem of the preservation of historic instruments and has published its findings in two publications, *Recommendations for Regulating the Access to Instruments in Public Collections* and *Recommendations for the Conservation of Musical Instruments: an Annotated Bibliography*. In order to limit the use of historic instruments and the inevitable wear and attendant risk of damage, CIMCIM in these *Recommendations* (and other authorities) advocates the making of good copies. Some such policy is particularly necessary as 'early music' flourishes and performers and audiences alike come to expect the use of 'authentic' instruments. This meeting sought to examine the degree to which copies of original instruments can succeed.

Obviously there is no such thing as an 'exact' or 'accurate' copy. Terms discussed at the meeting included 'facsimile', 'reconstruction', 'reproduction', and 'counterfeit' as opposed to 'authentic', 'period' or 'original' instruments. It was suggested by some that instead of calling an instrument a copy, it should be called an instrument 'after Ruckers', 'after Dulcken' etc.; it is clearly nonsense for a maker to claim that he is 'building a Ruckers'. Good new instruments can to a large extent be inspired by historic instruments while being adapted to the needs of the customer and present-day conditions. When a particular museum instrument has served as a model for a new instrument, the museum should be given due credit in any description of the copy without, of course, implying that

the museum endorses the new instrument as an exact copy.

More accurate copies can only be made by mastery of earlier techniques, and then only under certain conditions. It is not always sufficient to have seen the original instrument and studied the drawings and other documentation: further study may need to be made of the instrument and of similar instruments of the same maker or period. One of the tasks of a museum is to provide as much accurate information as possible about its instruments. Unfortunately, museums do not have sufficient financial means or enough trained staff to provide complete information. Thus, museum documentation is not always sufficient for a maker to create an instrument which plays and sounds well. Organising the data required to make a historically-informed instrument is a very complex operation even when only one maker of the type and period of the instrument is involved, even then some makers were more experimental than others. The task of a good builder is to transform physical materials into satisfying tonal characteristics. Measurements documented during restoration of original instruments are rarely adequate for the purposes of making a copy. An important role for museums is in encouraging co-operation among makers of historical instruments.

It is becoming increasingly accepted that museums should make copies of their own instruments, and parts of instruments, so that an impression of the sound of an original can be given while preserving it. It can also be valuable for educational purposes for a museum to acquire copies of instruments in other collections. Museums with their own laboratories can create copies under optimal conditions; other museums have to commission private makers to provide copies.

A major limitation on the accuracy of copies is that the same materials cannot always be used, particularly when the original instrument incorporates materials obtained from endangered species. In choosing the materials for a copy, the limits of authenticity should be defined.

Reflections on the 'Authenticity' of Musical Instruments

Martin Elste, Musikinstrumenten-Museum, Staatliches Institut für Musikforschung Preussischer Kulturbesitzt, Berlin

Ever since people were keen on collecting musical instruments, they also cared about the origin of these artifacts. Yet for a long time, the original condition of an instrument was of little or no interest to musicians and to music listeners. This attitude has quite substantially changed over the past two or three decades. Nowadays baroque music is almost exclusively performed on so-called 'original instruments'.

I assume all listeners with experience of western classical music have a vague idea of what 'original instruments' are. They all know that these instruments produce a sound distinctly different from that of those instruments played upon in symphony concerts and the like. The listeners have a predetermined expectation of how the instruments will sound when they are considered original. Also within the museum world, curators and restorers have a rather strict idea of it. Still, there is no common agreement about what 'original instruments' are and how they differ from normal instruments. The term and its common usage are more problematic that we all might think at first thought.

Three questions arise for discussion:

- What are 'original instruments' ?
- Which function and meaning do they have ?
- Which consequences can be drawn from the answers to these questions for the museum world ?

What are 'original instruments' ? To answer this question is not a matter of a couple of sentences. We have to search how this phrase has been used over the years and how its meaning has changed. Further we have to answer the question as to what extent it is useful to speak of 'original instruments'. The word 'original' appears in the English language as early as during the 14th century in the meaning of 'that existed at first, initial, earliest'. During the 17th century it also became the meaning of 'a work produced first-hand by the maker, a work of art that is not a copy or imitation'. And eventually during the 18th century a further meaning evolved: 'A thing of singular or unique character'.

All three meanings have little to do with what is meant by 'original instruments'. Only the first definition of 'that existed at first' makes sense if we refer to the relation between the period in which the composition was written and the period in which the instrument was made. Only such a time-interdependency would make sense. Accordingly, the English prefer the term 'period instruments' which has taken the place of 'original instruments' in organological and musicological writing. 'Period instruments' was formed in analogy to period furniture in the meaning of any specified portion or division of time: a term which creates a sensible relation between the composition and its instrumental medium without dealing with too much ideology. On the other hand, the English and Americans like to speak of 'authentic performances' and 'authentic instruments' - a somewhat unlucky use of this adjective.

The ideas of what 'original instruments' are have changed over the years. Already back in the 1930s this phrase was used to distinguish certain stylistically advanced performances. Yet it was used in a very general meaning. What was meant by 'original instruments' were those types of instruments pre-classical compositions were written for as opposed to symphonic transcriptions of those compositions. Thus, harpsichord as opposed to pianoforte. In those times, the alternative was transcription or non-transcription. And the non-transcription was a performance on 'original instruments'.

Hand in hand with the belief in the truth of *Urtext* there developed a fetishism for 'original instruments'. Performing 'early music' became determined more and more by the prestigious object in the hands of the musician, and the sonority of the specific instrument became an important point of consideration for judging a performance. A case in point is the harpsichord, where regional schools of harpsichord making have been pointed out by scholars and musicians as being important for the respective compositions. On the other hand, no one has as yet questioned the validity of a certain school of violin-making for a given style of composition. I do not know of any musician who cares whether he should use a Stradivari or a Stainer violin as the historically appropriate instrument for performing Bach. Part of today's ideal of the sound of 'original instruments' is a certain noisy quality. The 'original instrument' fetches back that individual sensuality of the timbre which has been lost by the modern instrument's timbre during its long progression towards mechanization.

Thanks to organological scholarship our thoughts about 'original instruments' have been narrowed down in the course of the last decades. Today, we should distinguish between five categories of 'original instruments'. These are categories that cannot clearly be separated, however.

1. The historical object.
2. The modern type, or usually called: a reproduction.
   This category covers those instruments at which the instrument maker has knowingly departed from details of the historical object. In a way, it is as modern and at the same time as false as reproduction furniture.
3. The reconstruction.
   It is always the more or less speculative result of organological research and covers the re-making of the original state of a historical object as well as the construction of all those instruments, historical copies of which are no longer fully or not at all available for measurements and study.
4. The true copy or exact copy.
   This term should be used only when the instrument maker has tried to re-create a historical object in every detail. It is a legitimate goal but it is always based on dated knowledge that is quickly superseded by further research.
5. The counterfeit.
   For this, the instrument maker tries in his new object to imitate the appearance of an old one, possibly by using historical parts. Usually, counterfeits are not true copies, because most historical objects were after all individual objects, and thus there is no financial interest in faking a specific object while the original is known to exist somewhere else. Sometimes specific features of instruments such as violin labels are counterfeits.

So we see the term 'original instruments' covers a variety of possibilities. Any normative definition of the term does not take into account its historical and aesthetic kaleidoscopic perspective. Thus I do not want to give yet another definition of 'original instruments'. Regardless which possibility we refer to, there are important considerations as to the function and the meaning of 'original instruments'.

The idea of 'original instruments' is strongly connected to the idea of authenticity in musical performance. After all, musical instruments are not merely objects for trading or collecting, but have a specific use within music. I want to discuss the 'original instruments' within the framework of music-making. Let me talk about a musician for whom 'original instruments' are of utmost importance. There are several reasons for such an attitude. In general, the musician wants to apply objective criteria for his performance within a historical context. It is his legitimate goal to transform the score into sound in an unadulterated manner. Concepts of *Urtext*, *Werktreue* and authenticity are part of this approach. Yet there are very few objective criteria, objective points of reference. The one which seems to be the least problematic, is the historical musical instrument, in other words the 'original instrument'. It is thus the basis of any historically oriented performance practice, and its aesthetic foundation is the notion that every composition is an expression of its time and can thus be interpreted adequately only with the means of its time.

The instruments from the realm of a given composition can undoubtedly give us historical and aesthetic findings which otherwise we can gain only theoretically. Yet important features of the instrument have always been kept variable, they needed and continue to need a subjective fixing by the musician or his instrument-maker or restorer. In the case of the string instrument the bow is the important link between the player and the instrument, its choice influences the sound and the instrumental virtuosity. The strength and material of the strings can hardly be selected according to

a fixed historical source, and neither bridge nor sound post can be chosen according to a definitive historical model. All the same, these are the parts which the violin-maker selects and fixes in accordance with the performer's - not the composer's - idea of how his instrument should sound. The fundamental problem lies in the opinion that the 'original instrument' should be more than the basis for the reconstruction of a historically correct performance, and it lies in the fact that this opinion does not take into account that the musical instrument is no more than the concrete relic of an anthropological system with socio-cultural components. That object which we traditionally call a 'musical instrument' and look at as such in a museum is mere matter with a certain material value and a certain market value. It is in itself not a document of a vanished musical culture. Only in co-ordination with the musician does it becomes an anthropological system. For centuries, this anthropological system has been made up of a clearly defined interdependency between composition, instrumentation, and habitat. The habitat was an acoustical as well as involving the social parameter of music-making. Woodwind and brass were preferably used for outdoor events, because their sound carries better than that of string instruments. The clavichord, as the instrument for the solitary player, stood in a chamber, the spinet in the drawing room, and the harpsichord in a hall. The word 'chamber music' originally referred to privately organized music-making in aristocratic houses and not to a classification according to the number of instruments used. Whenever a composition was performed within a habitat different from that one it was intended for, musicians used to transcribe it for a different set of instruments. Seen in this perspective, the Bach transcriptions of the early 20th century, such as those by Stokowski, Schoenberg and others, become aesthetically compelling.

This has changed considerably due to modern media. Since the advent of electrical reproduction, that is since the end of the 1920s, music-making has more and more departed from this, its original habitat. This is specially true for the acoustical room. It is an a-historic as well as aesthetically insensitive opinion to believe that neutral acoustics would present an optimum acoustical surrounding for the presentation of historical instruments. Such opinion eliminates an important component of the anthropological system with direct acoustical implications. Musical instruments are not simply objects in themselves. This distinguishes them from many other objects of art. They are by definition foremost tools. Only in the hands of a musician do they obtain a musical function. Otherwise they will be degraded to dead objects. It is this interlacing with the human acting, which the musical instrument shares with the ordinary tool. And this is a reason of the impossibility to display music as such in a museum. The intimate relationship between the instrument and its player makes it impossible for the musical instrument to serve as a definitive sound producing object of a lost time. Music as sound consists of an anthropological system in which the musical instrument is only a link in a chain of links influencing each other. Strangely, performing on 'original instruments' can only be perfect within its electro-acoustical chain of transmission. Because when we listen to 'original instruments' through loudspeakers, all the former considerations of the appropriate sound for the given habitat (and vice versa) can be neglected. This reduces the original network of references for the 'original instruments'.

What are the consequences within the museum world that can be drawn from these considerations ? If one wants to display as much as possible of this anthropological system it is important to show the mutual relations between musical instrument and man. I will give you an example for this:

In April 1984, Sotheby's offered for sale a violoncello which had been made around 1800 out of a then a hundred years old viol. This had been a quite normal procedure as you know. What made this 'cello special, however, was that it did not hide its origin. Pieces of wood had been added to the hanging shoulders of the viol's body, and in later years nobody had cared to re-build it towards its original state. Within a museum such an instrument would be the ideal object for the dynamics of

musical instrument making. There was a time not too long ago when restorers and scholars thought such a bastard ought to be reconstructed to its original state. Yet a viol transformed to a cello owing to the changing world of music-making is more authentic than any object re-built according to the intolerance of nostalgia.

This said, I think a museum should try to open the eyes of its visitors. And it is a museum's task to display musical instruments as testimonies of the various historical layers that form the anthropological system of music-making. Under such conception all kinds of 'original instruments' have their place as long as they are examples taken from the actual musical life and not from an idealistic, yet irrelevant museum culture. A museum of musical instruments is much more than a gallery of beautiful objects of art. It is always the attempt to visualize the dynamics of history. Historical instruments in their original state are part of this history as well as transformed instruments, reproductions, true copies, and even counterfeits. Pretence, however, should come in only within an exhibition about museum conceptions when pretence as such becomes the expressed theme of the exhibition.

The 'Exact Copy' as a Legitimate Goal

John Koster, The Shrine to Music Museum, Vermillion, South Dakota

There is something about a copy that is disdained. Copying is in many instances regarded as unethical or even illegal, as in cases of copyright or patent infringement. With works of art, copying their essential nature is usually regarded as impossible. The same attitude often prevails with musical instruments, which are what one might call works of 'high craft.' Certainly none of us would pay nearly as much for a copy of a Stradivarius violin or of a Ruckers harpsichord - even a very fine sounding copy - as we would pay for even a poorly preserved original instrument by these makers.

Nevertheless, the practice of copying pre-existing works of art or craft has a long and distinguished history. Even if Roman copies of Greek sculpture are generally regarded as inferior to the originals, they are still regarded as worthy of collection, preservation, display, study, and appreciation. One of the most memorable works of art to which I was exposed as a youth was a sculpture of a horse that was kept on a table in my school lounge. This was a modern cast of a work in the Metropolitan Museum in New York, which is now thought itself to be to be a Roman copy of a lost Greek original. Copies of this and hundreds of other works remain on sale in that Museum's gift shop. In some instances copies of certain objects are frankly displayed in modern museums, for example, casts of the reverse of coins or medals of which only the obverse sides can be seen directly.

Closer to the period from which come most of the musical instruments that we so admire today, artists of the Renaissance copied classical originals. In 1779 Josiah Wedgwood wrote in a catalogue of his ware that 'nothing can contribute more effectively to diffuse a good taste through the arts than the power of multiplying copies of fine things ...; by which means the public eye is instructed, bad and good works are nicely distinguished, and all the arts receive improvement.' A similar educational rationale was often stated when modern museums were founded in the nineteenth century. The original objects or plaster casts of classical sculpture displayed therein were intended to inspire the work of contemporary artists and artisans. Thus, viewed historically, there have seldom been serious ethical qualms about the making of copies or about working in past styles. The question, in practical terms, is not whether to copy or even why to copy but rather how to copy.

Before proceeding further, a few definitions are in order. In our wonderful English language, which

is estimated to have about twice the vocabulary of other languages, for any concept there is usually a large group of synonyms or near synonyms with subtly different meanings. Of the many words commonly used to describe objects that are modelled after pre-existing objects three are: Copy, Reconstruction, and Replica. The *Oxford English Dictionary* defines Replica as 'A copy, duplicate, or reproduction of a work of art; properly, one made by the original artist.' The word is correctly used by art historians, for example, to describe the paintings of 'St. Luke Drawing the Virgin' in Munich, St. Petersburg, and Lichtenstein judged to have been executed by Rogier van der Weyden or at least by apprentices or journeymen under his direction. These replicas are later versions of the original in Boston. If someone had reproduced the painting in the seventeenth century or if someone paints a version tomorrow they cannot be replicas: Rogier van der Weyden, the original artist, died long before. The word replica is often used by instrument makers and musicians who speak of making or playing modern 'replicas' of instruments by Ruckers, or Anton Walter, or whoever, but it should be understood that this is a vulgar misuse of the term. Indeed, it should not be applied at all to musical instruments, which cannot be regarded as unique works of art in quite the same way as paintings. It would be ludicrous to maintain that Laux Maler made one original lute and then spent the rest of his life making replicas of it.

Recently, at a professional meeting I heard someone refer in a paper to a modern 'replica' of Hans Haiden's *Geigenwerk*, no example of which has survived. Almost as bad a usage of a related word is found in a record advertisement which states that the performer of the medieval *Cantigas de Santa Maria* plays 'copies of European instruments of the time such as they can be seen on the miniatures illustrating the book of Cantigas.' A copy of an instrument shown in the *Cantigas* manuscript would, of course, be a miniature painting, not an actual instrument. The proper word for instruments made according to verbal descriptions or ichnographical evidence is 'reconstruction.' Francis W. Galpin, for example, made a reconstruction of a Roman hydraulis.

A reconstruction need not even be made as a functioning instrument. My forthcoming catalogue of the keyboard instruments at the Museum of Fine Arts in Boston includes several drawings that show the presumed original states of instruments that have been altered: for example, a Neapolitan harpsichord of about 1550, in the drawing of which the nuts, soundboard ribs, and 4' bridge and hitch-pin rail are based on evidence such as glue marks and scratched lines. Such a drawing can itself be called a reconstruction of the instrument's original state. If one were so ill-advised as to restore this instrument to its original state, the new nuts, 4' bridge, ribs, etc., that one would have to make would also properly be called reconstructions of the individual components.

An object made more or less accurately according to a pre-existing model that has been made by someone else is properly called a copy. With many artistic objects, copying can be a rather straightforward process. The most significant characteristics of a work of visual art are primarily superficial. A sculpture can be reproduced by making a cast, a painting by applying a few layers of paint to a canvas or panel. In many cases, adequate results can be attained by the copyist without even using the same materials as those found in the original. The copying of musical instruments is far more complex. The primary intention is usually to reproduce subtle acoustical and mechanical characteristics, not merely surface appearances. From the musical and organological standpoint, it is not necessary to reproduce the purely decorative elements of the original model unless these can be regarded as having some conceivable influence on tone or function. Thus, for example, it hardly matters what colour one paints a harpsichord case. The underlying materials and dimensions of the components of the case are far more important. On the other hand, the rose in the soundboard, while certainly decorative, can be regarded as having some influence on the acoustics of the soundboard; similarly, the applied mouldings around the edges of an Italian harpsichord can be regarded as

structural as well as decorative. Such elements should of course be included in any serious copy (although, needless to say, the original maker's initials in a Flemish or French harpsichord rose should be altered or omitted).

Let us take as given that the intention in copying a chosen pre-existing instrument is to reproduce its sound and touch as accurately as possible. The reasons for attempting to do this are various. A modern violin maker, for example, will wish to copy an Amati or Strad not because it is old but because its tonal characteristics are such that would be useful to a modern violinist playing the mainstream concert repertoire. To violin makers and their customers it is primarily the present state of the original that matters. A very fine copyist might attempt to reconstruct and to follow the working methods of the original master but will then proceed to patinate the copy, wear down the edges, and set it up as a modern violin. A lute maker, on the contrary, will copy a certain lute not because it is known to sound good - in all likelihood the original is unplayable - but because it is old and the copy can be used to perform old lute music in what is thought to be an authentic manner.

In either case of the violin or the lute maker, or, to introduce some cultural diversity, likewise in the case of someone wishing to copy the instruments of a gamelan for the performance of Javanese music, the assumption is that it is indeed possible to reproduce the musical characteristics of the original. It is by no means easy to prove that this can be done. 'The proof of the pudding is in the tasting,' but here we must compare two puddings, one of which is two or three hundred years old. Things are, to be sure, easier with the copy of the modernized old violin: because the intention is to reproduce the original as it now is, the copyist's success can, in theory at least, be judged by a direct comparison. The original instrument can be regarded as the scientific control, and the testing can even be blind. Nevertheless, even if the two instruments are perceived as identical at first, the possibility remains that the copy will change as it begins to age and that a comparison a year or ten years later will begin to reveal differences.

In the case of the lute or that of almost any historical instrument, the scientific control does not exist. Even if the original is playable, age, damage, alteration, or restoration can be assumed to have changed its touch and tone from what they were when the instrument was new. Further, the copying of almost any antique instrument involves some reconstruction. An original Renaissance lute will usually have been enlarged with extra courses of strings, a process involving replacement of the bridge, neck, and peg box; the copyist might well wish to make the copy as a reconstruction of the original state. A clavichord maker will have to reconstruct the proper tightness of balance mortices in the key levers. A woodwind maker will reconstruct the surmised original bore, circular in cross section, not elliptical, as the bore in the original almost certainly has become.

Plausible practical solutions to such problems of reconstruction are usually possible, but the questions remain: Is it possible to copy ? That is, can the qualities of a copy reasonably be assumed to match those of an unheard, unplayable, altered, or deteriorated original ? If so, how should one approach the process of copying ?

Some comfort, perhaps can be gained from examining in detail the oeuvres of certain great instrument makers of the past. Cecil Adkins has found, for example, a high degree of uniformity among the bores of Hendrik Richters's oboes[1]. I have found that the design of Ruckers-family *muselar* virginals, after a period of experimentation evident in Hans Ruckers's instruments of 1581 and 1591, remained highly stable in the work of his sons Ioannes and Andreas and of their nephew Ioannes Couchet. Henri Hemsch's earliest extant harpsichord, now at the Museum of Fine Arts in Boston, is virtually identical in design to one made by his master Antoine Vater. Hemsch's several later harpsichords

were also made according to a standard design. One could hardly maintain that Richters, the Ruckers, and Hemsch copied their masters' instruments or made series of demonstrably similar instruments with the intention of endowing each individual instrument with its own special character. That is, one may assume that these makers strove for a uniform quality from instrument to instrument and that the means of attaining this uniformity was to make instruments that were, insofar as practicable, of identical design. It follows that we today, by studying and following their designs and materials, should be able to reproduce their results. That is, if, down to the submicroscopic level, our copy is identical to the original, allowing for a reversal of chemical and physical changes that might have occurred within the original, then the copy should sound and function precisely as the original did when it was new. Obviously this ideal is unattainable, but it can, I believe, be approached. The principal means is, of course, the increasingly detailed study of antique instruments, most of which are in museums. Thus, those of us in the museum professions are closely involved, in one way or another, in the making of copies.

Accurate identification or analysis of materials and precise measurement of dimension are the chief necessities. Some other aspects are not so obvious. Many harpsichord copyists, for example, seem not to realize that it is necessary to saw a bridge to its curve if the original maker did so, rather than bending it to shape. At a more subtle level, it is possible, or even probable that some makers adjusted soundboard thicknesses according to the elasticity or resonance of its particular piece of wood. Thus, the soundboard of a true acoustical copy, made from a different piece of wood, might well be slightly different in thicknessing from the original. In other instances, it might not be clear whether certain components of the original instrument were sprung into place with consequent internal tensions or pressures. Soundboards now flat might originally have been slightly arched or crowned. Reasonable answers to such problems might well emerge, however, from more careful examination and precise dimensional and acoustical measurement of larger numbers of historical instruments. One consequence of such considerations is that we should not assume that an instrument has yielded all its secrets merely because a seemingly complete and accurate technical drawing has been made.

In recent years some makers have retreated from asserting that they make copies of specific historical instruments. Rather, they claim to have risen to the higher plane of having so fully absorbed a mode of working that they can independently work 'in the style of' some historical maker or period. One piano maker is even rumoured to have believed that he was the reincarnation of Stein. One wonders how he reacted when it was discovered that the 'Stein' piano which was his chief inspiration had actually been made by Louis Dulcken. Letting aside such apparent cases of lunacy, we should recognize that there is a danger in the view that is sometimes expressed in the form 'one copies what one does not understand,' that is, that the goal should be to understand a style and then work freely within it, synthesizing the result from one's self. Needless to say, there is a great danger of hubris in such a belief. One might even observe the reverse, that many makers do *not* understand what they do not copy; that there is a reason for everything that an old maker did and that modern copyists change things at their peril.

The Antoine Vaudry harpsichord of 1681 at the Victoria & Albert Museum in London has a bizarre but unquestionably genuine soundboard-ribbing scheme[2]. I followed this as faithfully as I could in a copy that I made some years ago. The tone of this copy, even with very weak quilling, was found, by direct comparison, to have considerably more carrying power than that of a similarly accurate copy of the 1728 Christian Zell harpsichord, which has a more conventional soundboard design. I have met several harpsichord makers who, in making so-called copies of the Vaudry, did not dare to assume that Vaudry knew what he was doing. They therefore altered the ribbing to a more normal pattern. All extant seventeenth-century French harpsichords, despite constants of disposition and action design,

are radically different from each other in case construction, scaling, ribbing, and materials. Some modern makers have taken this as a license to regard the early French style as a sort of menu from which one can make an idealized harpsichord by taking the scaling of one antique, the case construction of another, and the ribbing from a third in order to synthesize their own designs within the perceived confines of that eclectic style. Against this practice I would argue that each early French maker created his design from first principles, with a careful balance of individual elements of design. Thus, for example, the long scaling of an instrument like the Vaudry might require a rather heavily ribbed soundboard, while in a short-scaled instrument like one of 1667 at the Boston Museum of Fine Arts the soundboard would be lightly ribbed. Marin Mersenne hints at this sort of approach when he writes that the case walls should be thinner when a harder wood is used[3]. Thus, to make a composite harpsichord based on several instruments would be to misunderstand completely the intentions of the seventeenth-century French makers.

It should be evident to any careful reader of instrument makers' brochures and advertisements or to any alert visitor to early music trade shows that most modern instruments of historical type, even those claimed to be modelled after specific antique instruments, fall far short of even rather lax standards of objective historical accuracy. In a recent issue of *Early Music*, for example, one sees an advertisement for a 'Harpsichord after Carl Conrad Fleischer 1720 (Museo de Musica, Barcelona).' A two-manual instrument with compass GG to f''' is shown. The original harpsichord in Barcelona has, however, a single manual with a compass ending at c'''[4]. As objective evidence of how the Fleischer harpsichord might originally have sounded and functioned, the advertised instrument must be regarded as meaningless, and the museum's efforts in providing the maker with access to the original or with information about it might well be regarded as a waste of time.

A couple of years ago our Museum received a letter from a distinguished performer who wanted some information about one of our Haas trumpets. He wanted us to measure precisely the pitches of the natural series of tones and their deviations from the overtone series. He needed this data, he said, so that, starting with dimensional measurements that he had obtained previously from the instrument before it entered our collections, his workman could alter these dimensions in a copy so that the pitches of the copy would be more in tune than those of the original. I politely declined, making the quite truthful excuse that the variability introduced by the choice of mouthpiece and the lack of an experienced performer would render the validity of any pitch measurements questionable and that, therefore, we should not subject the instrument to the potential damage or wear that might be caused by playing it and subsequently cleaning it.

What we have is an example of Gresham's law, that the bad money drives out the good. If a performer can make an international career by playing altered copies falsely advertised as original instruments, what incentive is there for other performers to learn how satisfactorily to play accurate copies of baroque trumpets ? If a manufacturer can sell pianos 'inspired by the instruments of Andreas Stein' which so little reflect the round-tailed originals that they have angled tails, what incentive is there for a maker to produce more accurate copies ? If plastic harpsichord jacks and synthetic resin glues will suffice for a so-called 'Ruckers copy,' why bother making reproduction beechwood jacks with bristle springs and blind damper holes; why bother using hide glue ? It is time-consuming and therefore expensive for a maker to seek out and measure appropriate antique instruments and to make new plans, jigs, or reamers and to obtain appropriate materials for each different historical copy. Few makers bother.

To be sure, inaccurate copies have been around for a long time. The pianos made in the 1790s by the Graebner brothers of Dresden can be regarded basically as copies of J.A. Stein's instruments (though,

to be sure, they would probably not originally have been sold as such). The Graebners, however, failed to extend the straight part of the inner bent side as a brace to the belly rail, Stein's usual construction. But the Graebner brothers did not have radiographs or flashlights; they might not even have had access to a real Stein piano.

Makers today do not have these excuses, but, even so, the economic pressures are such that those who are conscientious need all the help that we, as museum professionals, can give them. It is appropriate for museums, as institutions of education, research, and cultural preservation, to promote the making of copies. From my former existence as a professional harpsichord maker, I can say that museums throughout Europe and North America are, in general, doing a good job in allow access to instruments, publishing reasonably priced technical drawings, and providing other forms of information.

It is also appropriate for museums to be more directly involved in making copies. As alternatives to restoration and to the frequent use of restored antiques for routine practice and performance, copies are increasingly being made within museums themselves or are commissioned from reputable makers. At our Museum, for example, we have commissioned a copy of our 1785 Jacques Germain harpsichord, and we already have acquired a violin after our 1693 long-pattern Strad. Who can say that the violin copy, in which the original baroque state has been reconstructed, is not closer to the sound of the original when it was new than a patched, regraduated, retrofitted old fiddle ?

Two questions of museum ethics should briefly be mentioned for further consideration. First, should museums seek to acquire copies of objects not in their own collections ? Many of the great collectors of the nineteenth and early twentieth centuries filled gaps in their holdings with copies. Sometimes, despite otherwise careful record keeping, the copies, now themselves antiques, are no longer recognized for what they are. A case in point is a crumhorn in the Galpin collection, which was acquired by the Museum of Fine Arts, Boston, in 1917. Among historical crumhorns it is exceptional, being covered with leather and its curve having been formed by the cutting-out of wedges. A radiograph and description are included in a standard book about crumhorns[5]. Yet, the instrument is another of Galpin's copies or reconstructions. In a typescript checklist of his collection from 1911 that I recently came across, Galpin listed this item as 'Cromorne ..., as used c. 1600. Italy.' This wording 'as used' was Galpin's code for describing a newly made instrument. By the time of Nicholas Bessaraboff's catalogue of the Boston museum's instruments, the modern origin of this crumhorn had been forgotten[6]. Thus, however innocent and however legitimate in intent was Galpin's addition of this instrument to his collection, not only has the public been misled by its exhibition, in the context of a museum, next to genuine antique instruments but also, eventually, scholars have been misled.

A second question that might be considered is whether museums should actively seek to prevent misleading marketing of instruments claimed to have been modelled after objects in their collections. The educational mission of an institution owning a single-manual four-octave harpsichord is ill served if a two-manual five-octave instrument is advertised and sold with the name of the original maker and the location of the original instrument prominently displayed. Perhaps makers, as a condition of being given access to instruments or of purchasing technical drawings, could be required to sign a pledge not to cite the original instrument or the museum that owns it if their copies do not meet a minimal standard of accuracy.

With other kinds of objects museums sometimes engage in exclusive licensing agreements. According to former director Thomas Hoving, the Metropolitan Museum in New York, as a marketing agency,

has perpetual exclusive rights to make and sell reproductions of King Tut's jewellery, the originals of which are in the Cairo museum[7]. It would be most unfortunate if this concept of exclusivity were extended to musical instruments. The firm that in the 1930s restored Mozart's Walter piano in the Salzburg Geburtshaus seems to have had exclusive rights to produce copies of it. Other makers have been refused access to the original instrument, while the so-called *Meisterkopien* seem to have been more or less run-of-the-mill productions, with keyboards, for example, patently different in detail from Walter's and Mozart's keyboard. The difficulties of the first stages of the modern early piano revival were significantly compounded by this shameful situation. Mozart's music belongs to the world, no matter who happens to own the autograph score. The same should be true of the design of his piano and of all musical instruments by the masters of the past.

NOTES

1. Cecil Adkins, 'Oboes Beyond Compare: The Instruments of Hendrik and Fredrik Richters,' *Journal of the American Musical Instrument Society* **16**, 1990, pp.42-117.
2. Derek Adlam, 'Restoring the Vaudry,' *Early Music* **4** (3), July 1976, p.265.
3. Marin Mersenne, *Harmonie Universelle* [Paris, 1636], Livre Troisiesme des Instrumens à chordes, prop. 1, p.102.
4. Romà Escalas i Llimona, editor, *Museu de la Mùsica 1, Catàleg d'instruments.* Barcelona: Ajuntament de Barcelona, 1991, p.202.
5. Barra Boydell, *The Crumhorn and Other Renaissance Windcap Instruments.* Buren, The Netherlands: Frits Knuf, 1982, p.142 and plate 3.
6. Nicholas Bessaraboff, *Ancient European Musical Instruments, an Organological Study of the Musical Instruments in the Leslie Lindsey Mason Collection at the Museum of Fine Arts, Boston.* Cambridge, Mass.: Harvard University Press, 1941, p.81.
7. *Making the Mummies Dance: Inside the Metropolitan Museum of Art.* New York: Simon & Schuster, 1993, p.410.

Measure for Measurement

Eszter Fontana, National Museum of Hungary, Budapest

One of the main practical difficulties in preparing technical drawings in a traditional way is in taking precise measurements. Factors such as the lack of fixed points of reference to measure from, errors in transferring measurements, distortions resulting from the thickness of the drawing instrument, changes in paper size and size change when copying are well known. When a drawing is prepared, measurements are taken from an object which itself has probably changed in size and has distorted, for instance through wood drying out. Some of these changes in size and shape, however, are inadvertently rectified on the drawing paper: a bent flute becomes straight again, the bottom-board of harpsichord buckled by strain from the strings is drawn as if it were still flat, etc. The result is a drawing which is made even more distorted through inconsistent rectifications of its present state as well as errors in measuring, and which cannot serve as a true mirror either of the present or the original size and shape of the instrument.

When making a drawing, it may be possible (or even necessary) to obtain more precise measure-

ments. To illustrate some lessons to be learnt we will take as examples a clavichord, a harpsichord and a dulcimer.

The Clavichord

Our museum holds a travelling clavichord which Leopold Mozart purchased for his son in 1763 from the master of Augsburg, Johann Andreas Stein. This instrument was shown in the exhibition organised by the Kunsthistorisches Museum, Vienna, on the occasion of the recent Mozart anniversary. The catalogue of the exhibition contained an essay on the instrument. The thorough studies which preceded the exhibition dealt not only with its history, but with its size and comparisons of size. Analysis showed that the builder used the *Werkschuh*, the unit of length used in Augsburg (the measure used in all Stein's instruments). Using this old unit, therefore, one gets a more precise idea of the proportions of the instrument. Knowing these proportions, we can have a clearer view of the instrument's original size. Recalculating the sizes based on the old non-decimal system may also give a clue to the builder's ideas of scaling. As it was intended to be a travelling instrument, its compact size was achieved through shortening the scaling considerably, starting from the centre. The degree and structure of this shortening can be readily understood if the sizes are given in the old system of units. The spacing of the strings on the bridge is, in fact, the basic unit in this old system.

The Harpsichord

The instrument dates back to 1571 and has been altered several times. It is in an incomplete state even today. The instrument suggested several questions to which we tried to find answers through a series of investigations. We used various techniques to analyze what survived from the paint and strings, prepared radiographs and also had a technical drawing prepared by a professional. We found, however, that no matter how attractive the drawing appeared, it was not fit for use. Its shortcomings must have been due to the accumulation of the factors mentioned above. I was supposed to provide suitable data for the draughtsman: however, I lacked anything beyond information of a general nature. The only lesson we learned was that good intentions and endeavour are not enough. We had no choice but to start again. In measuring the instrument as precisely as possible this time, we did not restrict ourselves to physical measurement; instead we attempted to ascertain the sizes and proportions unique to this instrument and to explore the principles underlying its structure. This series of measurements took a very long time, but it did produce the desired results. We found the proportions peculiar to the instrument, from which we could guess the original unit of length. We also found some marks left by compasses, from which we managed to reconstruct the principles of its construction and to infer the size the builder intended and the extent to which the wood had shrunk; the deviations arising from the process of construction and from defects in the builder's work.

The Dulcimer

A trainee restorer prepared a technical drawing of an 18th-century dulcimer last summer in connection with a restoration. Lessons learnt from experience warned us to start by exploring the measurements. Our search was all the more conscientious because the rose and the frame usually contain basic sizes. The most important result of the measurement analysis was that we were able to ascertain the instrument's country of origin, Switzerland. The first important piece of information for this was the unit of length, which we managed to discover and identify. Knowing the country whose instruments we had to study more thoroughly, we were soon able to do determine some country-specific aspects such as the shape of the wrest-plank, the design of the tuning-pins, the rose and the bridge. The drawing was prepared with great care. However, control measurements suggested that notwithstanding this, it contained an error. The trainee restorer had used, following instructions at the academy, the

modern unit of length (centimetre) rulers, compasses and plummet. Her error was probably unavoidable since these instruments allow a millimetre precision at best. Added to this were the factor discussed above such as inadvertent rectification of changes in size due to shrinkage of wood, etc.

All the above suggests the following conclusions: only imperfect drawings can be prepared with the instruments and the usual methods of drawing available at present, and the extent of the imprecision and the usefulness of the resultant drawings are far from unimportant. As most of the technical drawings serve as the basis for the preparation of 'replicas', a serious defect of most currently available drawings is the lack of information on tolerances as well as the points, lines and surfaces from which measurements start, although the maker of a replica should use the very same points.

Such imperfect measurements result in drawings having faults in quite unpredictable places, and even when we notice that the drawing is wrong, we find it hard to say why! Consequently, it is equally difficult to list the most frequent types of error and to draw lessons from them. It would be highly advisable, therefore, (and I consider CIMCIM to be the appropriate forum) to work out recommendations for the starting points for measurements for technical drawings of each instrument type as well as the principles and order in which a drawing should be prepared. If the measurements are analyzed simultaneously with the preparation of a technical drawing, it becomes easier to understand the principles on which the instrument was originally made, to reconstruct the original sizes, and to explore the intentions of the maker and any mistakes he made in his measurements or in the course of construction. Similarly it appears to be useful for the original unit of length to be given where known.

Radiographing Musical Instruments: a Useful Method in Organological Research

Mia Awouters, Brussels

Although I am aware of the fact that many curators of collections with musical instruments cannot currently rely on services with a radiographic equipment, I would like to talk about radiography as a useful modern technique for organological research. An radiograph is a very concrete source of information for a better understanding of the musical instrument. It reveals the internal structure of the instrument, as well as previous alterations, repairs, the density of materials, woodworm damage, etc.

Although Wilhelm Röntgen scanned the human body soon after his discovery of X-rays in 1895, their application in the field of organology is quite recent. To my knowledge, the first printed evidence of radiographing instruments dates from 1949. The Galpin Society Journal of that year published an article from Eric Halfpenny 'The English 2- and 3-Keyed Hautboy' in which he shows a radiograph section of an oboe[1]. In the next twenty years, many of his articles included radiographs of wind instruments.

This fact shows one of the main problems of the technique. Because many wind instruments have quite small three-dimensional dimensions, they lend themselves well to radiography in the traditional way: this means radiography at a short focus to film distance and on films of small sizes. The short distance between the source and the object, put against the film, gives a considerable distortion because of parallax, especially in three-dimensional objects; several parts of these objects cannot be

in contact with the film. The narrow diameter of oboes and other small wind instruments has the advantage that no part of the instrument lies far from the film, which gives a quite reliable picture. In the case of jointed instruments, the length can be reduced to fit the size of the film, by putting several parts separately. The example, given by Halfpenny, shows the bell, upper and lower joints of the oboe in that way.

In spite of the limitations, the information given by those X-ray films is very useful. Thicknesses of the sides, the course of the bore, the shape and undercutting of the finger-holes are clearly shown. A complete picture of a bigger instrument, radiographed in this conventional way, can only be obtained by exposing successively different small sheets of film. The multiplicity of required films and the differences of parallax between them, makes the total view of the instrument hardly legible.

The method encountered a great deal of criticism in the fifties, especially regarding other types of instruments, such as stringed instruments. At the International Lute Colloquium, organised by the Centre de la Recherche Scientifique in Neuilly (France) in 1957, Michael Prynne insisted upon the importance of having a good knowledge about the internal structure of musical instruments. In the following discussion he stated that radiography was a 'technique to which one hardly has access and with little value as a research method for the knowledge of structural details'[2]. Consequently, it was only used sporadically in the field of organology.

It is greatly to the credit of Friedemann Hellwig (former conservator at the Germanisches Nationalmuseum in Nuremberg) to have started systematically radiographing all types of instruments in the seventies. He also experimented with radiography at a greater distance and on large sheets of paper, for instance with harpsichords[3].

About the same period, the Brussels Museum of Musical Instruments could rely on the services of the Royal Art Patrimony Institute, and started with some radiography programmes. Already in the early seventies, a large-format film was used at the Institute for large paintings and sculptures[4]. Because large-size X-ray films are not available, one had to turn to a graphic film, obtainable in rolls of maximum width 1.2 metres. From 1973 on, tests on this type of film were made with musical instruments[5].

The advantages of this type of film are:-

- the stability of the material. This factor is important for two reasons. It allows the handling of large sheets, without risks of tearing. The picture itself remains stable, which allows a better accuracy of detailed information.

- the possibility of a great radiation distance between focus and film/object. This long distance (at least 3 metres) reduces the effects of parallax, which are increased by the three-dimensional dimensions of instruments. Linear projections over long distances enable us in many cases to measure constructional details with near-total accuracy.

- the format of the film allows us to radiate bigger instruments, such as harpsichords on one sheet of film and avoids the laborious pasting work of the traditional method to match the various films into one full picture, which hardly can be accurate.

Anyway, the classical film (format 30 × 40) remains a useful medium for smaller objects and the

radiography of details from a bigger instrument. The technique also proved to be adequate in defining options for the restoration of instruments. For instance, the course of the damage caused by woodworm can reveal the need for intervention.

Many instruments of all types, belonging to the Brussels Museum of Musical Instruments, have been radiographed on large-format films. Some examples show the value of this method:-

5-course guitar by Cassas, Barcelona, ca 1800 (inv. n° 3184) [Fig.1]

Two different views of the guitar have been put together on the photograph: at the left, the one taken in linear projection and the other one in an angle of 78°. The internal structure, revealed by the radiographs, confirms traditional Spanish guitar-making rules. The upper block forms one whole with the heel of the neck, the back being thicker at this point (see the white patch at the top of the back). The sides of the instrument fit into two grooves. Two thin transverse bars at the inside of the belly fit in triangular wooden strips, glued to the ribs. At the bottom, the reinforcement of the ribs, is rather thin. Different materials, used for decoration, appear in various densities. Structural details show up more clearly in the right picture because of the three-dimensional effect. The straight one is more appropriate for measuring constructional details.

Harpsichord by Vincent Tibaut, Toulouse 1679 (inv. n° 553) [Fig.2]

This is a reduction of a full-size radiograph of the instrument without keyboard and jacks. The distance between focus and film was 4 metres, which required an exposure of 25 minutes. The radiograph of this instrument was been taken because this harpsichord is almost hermetically closed by a wooden board of more than 3 cm thick, glued to the original bottom. Earlier restoration has been carried out improperly. The radiograph shows that six rectangular pieces were cut out of the original bottom, most probably in order to put a new barring on the belly. In general, the materials used and their density provide clues which enable the picture to be interpreted. The triangular lateral supports and the two bars across the bottom are all attached by means of nails. They seem to be original.

Lutes by Johann Christian Hoffmann, Leipzig, 1716 and 1730 (inv. n° 1559 and 3188)

Both these instruments have been radiographed in order to compare the barring inside the belly. The barring of the earliest lute appears to be original, whereas the one on the new belly of the 1730 instrument has no historical basis. The curved bass-bar and the thin fan-bars below the bridge have been replaced by one straight bar on the latter instrument. In other aspects, historical building has been confirmed: in both instruments, the joints between neck/body and neck/pegbox have been secured by iron nails.

From other interesting historical lutes, only the bodies with the attachment to the neck have been radiographed at a distance of 3 metres, in order to reduce the effects of parallax as much as possible. They proved to be a reliable basis for measuring the positions and the thicknesses of the bars. To check this reliability, a radiograph from the belly of an open instrument was taken in the same circumstances. Measurements taken from a radiograph of a theorbo by Pietro Railich (inv. n° 1569) and from the belly itself were almost identical.

Cornetti of the Brussels Museum have been radiographed in small groups, in order to compare structural features[6]. Most of them are said to be Italian [ill. 3, inv. n° 1208]. The bore, thickness of the sides, disposition of the finger-holes with little undercutting, several bindings under the leather to hold two pieces of wood together, are quite the same. One small 'cornettino' could be of German

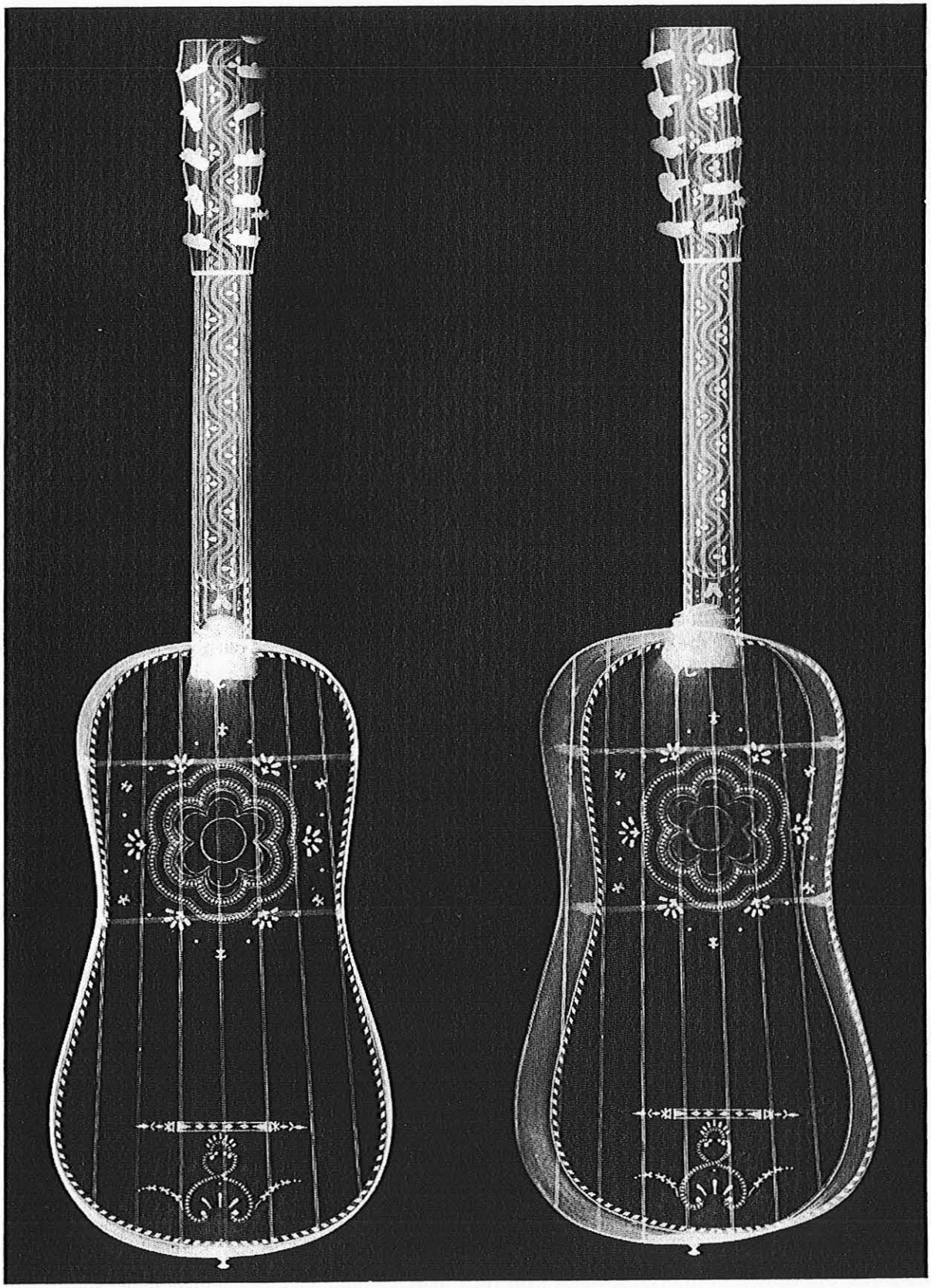

Figure 1 Radiograph of 5-course guitar by Cassas

origin (inv. n° 1187). The radiograph shows only one binding at the bottom, a metal reinforcement on top between wood and leather, finger-holes spaced in groups of three with oblique undercutting of the middle ones.

Conclusion

A full-size radiograph is a useful source of information for the knowledge of constructional details on historic musical instruments. As such, the technique is a valuable contribution for the making of reliable copies. Yet, one has to be careful in the interpretation of these pictures: distortions due to parallax must be calculated and the fact that not all materials - such as thin glue-marks - clearly show up on the film can lead to misunderstanding some aspects.

NOTES

1. E. Halfpenny, 'The English 2- and 3-Keyed Hautboy'. *The Galpin Society Journal*, **II**, 1949, pp.10-26.

2. M.W. Prynne, 'Comment noter et conserver les mesures des luths anciens'. *Le luth et sa musique* (Colloques internationaux du Centre national de la recherche scientifique, Neuilly-sur-Seine, 10-14 septembre 1957). Paris, C.N.R.S., 1958, pp.239-243.

3. F. Hellwig, 'Die röntgenografische Untersuchung von Musikinstrumenten'. *Maltechnik Restauro*, **2**, 1978, pp.103-115.

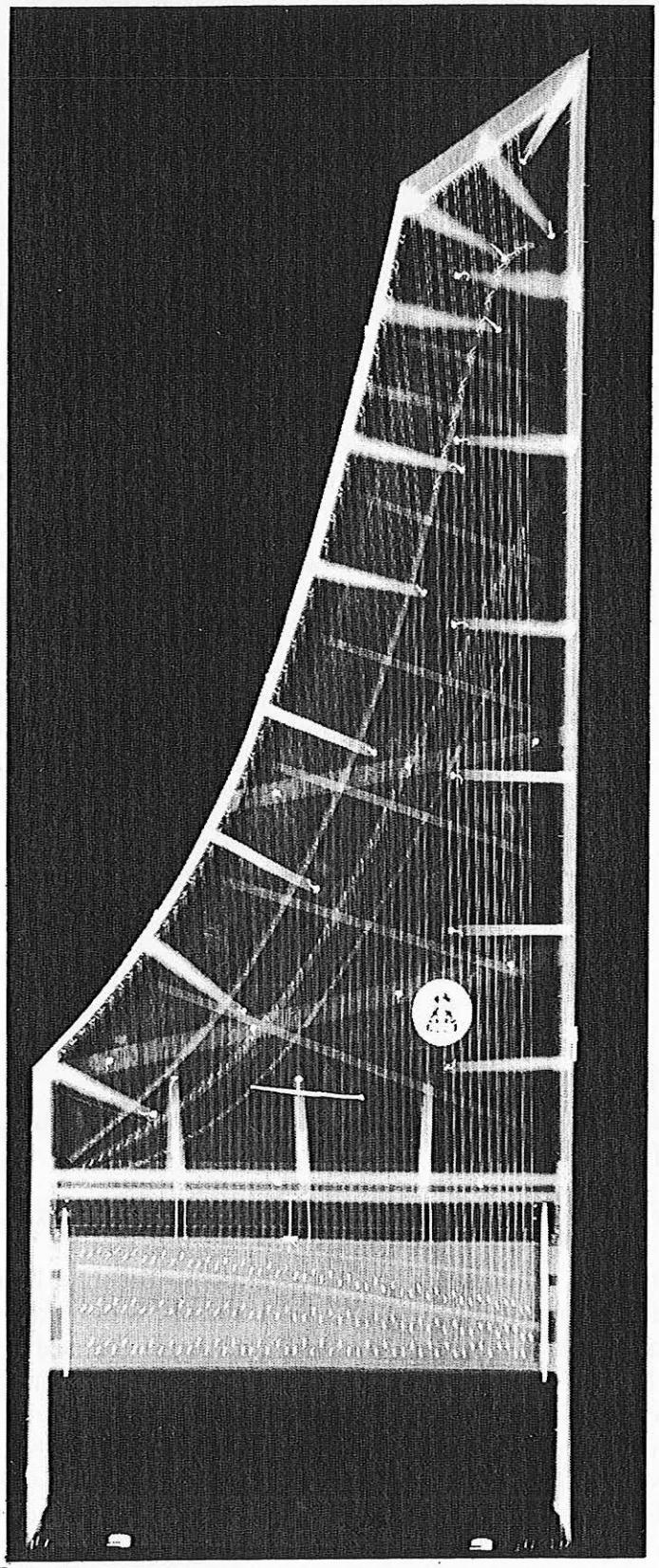

Figure 2 Radiograph of harpsichord by Vincent Tibaut

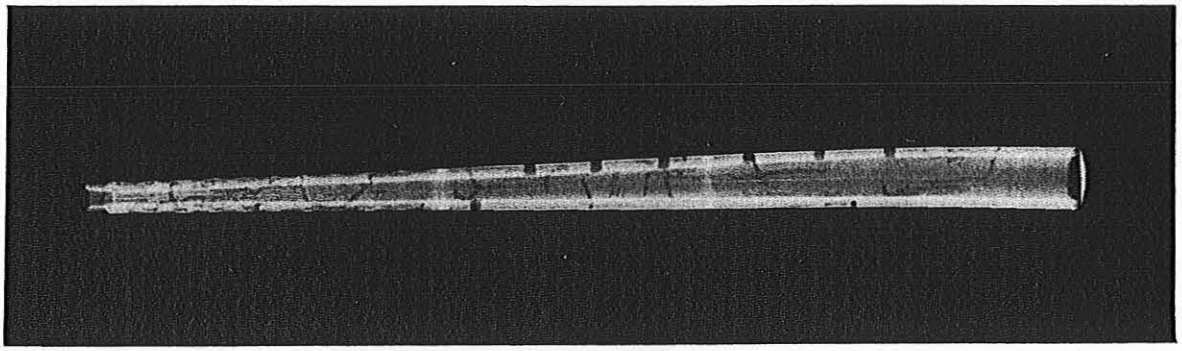

Figure 3 Radiograph of cornett

4. i.e. the graphic Cronaflex Projection Film B (PBF-4) from Du Pont de Nemours. The properties of this film for radiography are described in G. Van de Voorde, 'The Radiography of Rembrandt's Night Watch. *Bulletin van het Rijksmuseum*, **24**, 1976, pp.52-67.

5. The procedure of radiographing three-dimensional objects is described by G. Van de Voorde, 'Het volledig radiograferen van volumineuze driedimensionale kunstvoorwerpen'. *Bulletin van het Koninklijk Instituut voor het Kunstpatrimonium*, **XVII**, 1978/79, pp.22-39. The application to musical instruments is described by M. Awouters, 'Bruikbaarheid van de radiografie voor de instrumentenkunde. Historische en moderne luitbouw'. *Ibidem*, pp.40-52, and M. Awouters, 'X-raying musical instruments: a method in organological study'. *Revue belge de Musicologie / Belgisch Tijdschrift voor Muziekwetenscha*, **XXXVI-XXXVIII** (1982-1984), pp.207-215.

6. Descriptions of the instruments and pictures of some radiographs can be found in E.H. Tarr, 'Ein Katalog erhaltener Zinken'. *Basler Jahrbuch für historische Musikpraxis*, **V**, 1981, pp.11-262.

The Provision of Plans

Jeremy Montagu, The Bate Collection of Musical Instruments, Faculty of Music, University of Oxford

Why do we do it ? Why do we go to the trouble of providing plans ?

There are, of course, a number of reasons. The most basic, and one that we would probably only admit to among ourselves as a prime reason, is to make money. How the rest of you are placed, I don't know, but until we got our Friends organised, and through them a capital fund which provides a little interest each year, we had no purchase fund, and we still have nothing from the University for this purpose. And yet we have bought a lot of instruments in the eleven years that I have been Curator, most recently the only Hieronymus Albrecht Hass clavichord in Britain - very frustrating, we have had it for more years than anyone can remember as a loan, and then every curator's nightmare, the lender who needed money - so we had to raise a great deal of money, £30,000, just to keep what we already had. And this is the main way that we do raise money, by our sales. We sell guides, catalogues, postcards, and so on and so forth, and plans of our instruments.

We are very fortunate. Our own publications are written on my computer and printed on the Faculty's photocopier. Thus they are very easy to produce, and I would encourage other curators of small collections like ours, 1500-2000 instruments, to produce Check Lists and small sectional catalogues like these which are extremely valuable as references, to know what is in a collection. A result of this mode of production is that the profit margin is high! Most of our plans are published the same way because all woodwind smaller than bassoons will fit an A3 sheet; we don't make as much profit off bassoons because we have to pay to get the plans printed in the local architects' copy shop. But we have been very lucky with plans, too. Initially we inherited two plans from Edgar Hunt when we bought his recorder collection, both of the famous Bressan treble recorder, one drawn by Fred Morgan and the other by Friedrich von Huene. Both of these gentlemen permitted us to sell copies of these drawings. Then Ken Williams got a grant from the Australia Council to come to England to draw plans of as many of our instruments as he could during a summer, to provide a resource for Australian instrument makers. Ken was a member of FoMRHI, the Fellowship of Makers and Researchers of Historical Instruments, and it was in that context that he had got the idea of doing this. We, of course, supported very strongly his application to the Australia Council because I knew that we would benefit too. Several other people have drawn plans because they wanted the information and they were kind enough to draw a saleable plan for us in return for being allowed to measure it. Others have done so in return for hospitality while they have been in Oxford, and for payment of their fares to travel to us. So we have built up a big list, second only to the Gemeente Museum in The Hague, as you will know if you have looked at that very useful list by Rob van Acht (published by Moeck), and we are increasing it all the time.

I glanced just now at another reason for providing plans: as a resource for makers. This, leaving aside the need for money which affects us all when we see just the instrument we want appearing in the sale room, this is the real and by far the most important reason for providing plans. As we all know, there are not enough original early instruments around for everyone who wants to play them, and anyway nobody in the eighteenth century was playing on instruments two hundred and fifty years old. The only way to have enough early instruments, and the only way to have ones that are not two hundred and fifty years old, is for modern makers to produce reproductions. And for that, they need plans.

Or at least they need to have measurements of the instruments. Which brings us to a third reason for providing plans. Every time an instrument is measured, it risks being damaged. Quite apart from the risk of being dropped when it is handled, contact with measuring tools is inevitably a risk. If we provide plans we can forbid any further measuring of those instruments for which we have plans, unless and until the person who wants to measure it can prove that the existing measurements are inadequate in some respect.

I mentioned contact with measuring tools. One of our bugbears has been the use of metal measuring tools, and it is one that we need to look at again. I would agree that we must ban hardened steel caliper gauges - they are dangerous in even the most careful hands. But T-gauges are another matter. A T-gauge with very smooth and properly rounded ends such as the Mitutoyo is a great deal safer than some plastic discs I have seen. I have had people come into the Bate, quite reputable makers, too, with plastic discs with edges just as sharp as their reamers. Obviously, they want a nice clean cut-off point for the measurement. But if I were to let them use those discs on our instruments, we would soon have instruments with stepped bores. They were surprised that I banned the use of their plastic, at least until they had rounded off all the edges, and more surprised that I permitted a steel T-gauge, but gentle use of rounded, smooth steel is infinitely safer for the instrument than the use of sharp-edged, rough plastic.

Ideally we need a non-contact system, but I have not found one yet that works and is affordable. Radiography is no use because of parallax problems, although of course they are always useful for additional information. The best I have met yet are machines like Rod Cameron's and a rather better German version that reads out digitally or into a computer instead of on a chart recorder like Cameron's; it didn't need as much setting up, calibrating, and checking as Rod's, either. These are still invasive contact machines, but the contact is very light and the result is a complete picture of the bore rather than a series of steps, which is what you get with T-gauges or discs. As so often, it comes back to money. There are better methods used in industry, but while they can afford a few thousands or tens of thousands of pounds to make sure that their aeroplane engines or atomic energy components are the size they want, we can't. We cannot even afford to buy one of Rod's machines, or one of the German ones, and then pay somebody to measure all our instruments so they never have to be touched again. And certainly I have not got the time to do it. Nor could one insist that all visiting makers could use only such a machine even if we were to provide it, for some would not have the skill. Though if we could afford to buy one, it would be a very strong temptation to insist on just that; if this is the safest method I know, would it not be right to make that the only permitted one ? Especially as it is also the most accurate method that I know when it is properly handled.

This brings me to the next problem. Are our measurements accurate, our plans adequate ? Fundamentally, no. No maker really trusts anybody's measurements except his own. Here one just has to be tough and say, 'what we have is good enough and anyway it is all you are going to get'.

Is any plan adequate ? And here again the answer is no. It lacks one essential element. It is silent. A good plan should, of course, have a table of pitches. Some of ours have, and some, because the measurer was not an oboist or whatever, don't. Anyway, I don't really believe that it is possible to produce definitive pitches on any instrument that requires a reed. Two players with two reeds will produce radically different results. Our oldest oboe, the anonymous so-called Galpin, was noted by one payer as playing at A=407 hz. Bruce Haynes was sure it was A=392. Both were right - with their reeds and their playing techniques. Even two players with the same reed will get different results.

Pitch is not the main problem, though; it is the tone that counts. If the copy doesn't sound like the original, it is not a copy. John Koster pointed out that sound changes over the centuries. Nevertheless, the sound of the original instruments today is the only evidence that we have of what they did sound like. Either we take that as evidence or we proceed by guess-work. How do you find out whether the copy does sound like the original ? I will allow makers to play the instrument, especially if they bring an example of their own reproduction. If the reproduction is at the same pitch as the original, and if it is made accurately, I will allow them to mix the joints, our top, their middle, and so on. We have learned quite a lot that way, among other things that no plan is adequate. It will get you so far, but unless you are Bressan, you are never going to produce a Bressan recorder. It is like a map in that respect. It will teach you how to get from A to B, but it will not tell you that Antwerp is a beautiful city; it will not tell you what the streets smell like, how the stones feel under the foot, or what it feels like to be here. Nor will the new technology of computer virtual reality tell you these things either. You have to be here. And you have to play the instrument. If you cannot, one dimension is missing from the information, and this, depending on the local rules, may mean that all the plans from certain museums may be missing that dimension. A recording, however good, is not the answer, either; that is like the computer virtual reality; it is virtual, but it is not real.

We still have other problems. We cannot yet provide plans of our early cors anglais; we have not been able to think of a way to get accurate measurements round the curves. We cannot provide plans

of any of our brass. Partly again the problem of accurate measurements round the curves, but with most of them the sheer problem of getting a tool of any sort through the bore. Anyone can measure the outside, of course, but that doesn't tell you what the inside is like, and it is the air on the inside that makes the noise. My ears tell me that this is the problem with most of the modern reproduction brass instruments on the market today; they don't sound much like the originals, and while some of it is due to bad playing practice and the use of modern mouthpieces, a good deal of it is due to the instruments themselves, which quite simply are not accurate copies, and they are not accurate copies because nobody is providing accurate information about the bores of original brass.

What I said just now brings me to my final point. And it takes us back to where we started. Why do we do it ? Why do we go to the trouble of providing plans if makers are going to fake their instruments with plastic bores, with extra holes, with modern conveniences, and if players are going to stick modern mouthpieces in them and play them with modern playing techniques. Put like that, there is not a lot of point in the whole process, is there ? I suppose from the museum point of view it is part of the documentation of the instrument. From the didactic point of view, and most of us believe in educating the public rather than just entertaining them, like the many Disneylands we all have around us, we are providing information about the instrument and teaching people more about it. And from the early music point of view, there are a few players in all areas who do care about original sonorities, who care passionately about making the right sounds, who do not want to fake their instruments or their playing techniques. Ultimately we provide our plans for them and for the makers whom they inspire and who inspire them. Maybe, with the information we provide, new and better craftsmen will appear, and one day again there will be a Bressan, a Ruckers, a Stradivarius. And once again we shall hear the real sound of music.

Materials from Endangered Species in Musical Instruments

Laurence Libin, The Metropolitan Museum of Art, New York

Musical instruments and accessories often incorporate materials from species now threatened with radical depletion or extinction. Commonly encountered examples of these materials, which may serve structural, ornamental, or symbolic purposes, include tropical hardwoods such as Brazilian rosewood (*Dalbergia nigra*), grenadilla (*Platymiscium pleiostachyum*), and Caribbean mahogany (*Swietenia mahagoni*); elephant ivory; sea turtle shell; and certain reptile and mammal skins that provide drum and chordophone membranes. In addition, exotic feathers, ungulate horns, marine shells, coral, whalebone (baleen) and other substances from endangered wildlife occur particularly in ethnic instruments, which are among the most attractive and desirable to casual collectors such as tourists.

When museums display such instruments or promote their restoration and 'authentic' replication without commenting on species depletion, what attitude is conveyed to our public ? Do we unwittingly contribute, if only in a small way, to the decimation of vulnerable fauna and flora ? Are adequate substitute materials available, or can they be developed ? Museum professionals ought at least to discuss these issues. Opting out of controversy by claiming concern solely for art or technology or history isolates us from broader social concerns and fosters a sense that museums are irrelevant, even irresponsible.

Many instrument makers and restorers now refuse on principle to use raw materials from endangered

species. I propose that CIMCIM should join with these concerned craftsmen and with other ICOM colleagues to condemn and, by our example, restrain ungoverned exploitation of disappearing fauna and flora. Furthermore, we should deplore waste of existing stocks, because a case can be made for using up these supplies in a thoughtful manner. The U.S. Fish and Wildlife Service warehouses confiscated material at certain airports and dispenses it on permanent loan to nonprofit institutions such as museums, where it may be used in restoration provided a log is kept of this usage. The widely publicized but, I believe, misguided burning of 2500 confiscated elephant tusks worth US$3 million, ordered in 1989 by Daniel arap Moi, president of Kenya, benefitted no one and has led to further losses: on June 4, 1993, a pile of tusks was publicly burned in Taiwan. Had those tusks been given ceremoniously to nonprofit scientific and cultural institutions for their controlled use, the same political purpose would have been served. ICOM should endeavour to educate authorities concerning a more sensible and sympathetic disposition of confiscated materials.

Useful amounts of ivory, tropical hardwoods, baleen, and so forth disappear less dramatically when unwanted pianos, furniture, old whalebone-stayed corsets, etc., are thoughtlessly discarded, or when captive animals die or trees fall in storms. CIMCIM should encourage legitimate extraction and recycling of their valuable components especially when, in exceptional cases, no adequate substitute may be available - for example, to match a missing piece of rare veneer.

The important point is that lucrative trade in imperiled species must be discouraged. Although efficient wildlife and habitat management occasionally requires culling burgeoning populations, so long as a profitable market exists unregulated killing and smuggling will continue. I believe that the right of species to survive outweighs any consideration of aesthetics and 'authenticity' of objects or of monetary gain, and that museums should lead in conserving the species and habitats that form mankind's common heritage.

About 115 UN member nations signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) prohibit or restrict international movement of materials from endangered species. An appalling, 22-page-long inventory of these species is available in the U.S.A. from the U.S. Fish and Wildlife Service of the Department of the Interior, and from corresponding agencies in other countries. All museum libraries should possess copies of this document, and curators should urge instrument makers and restorers to consult it before obtaining materials. Museums as well as tourists, musicians, dealers, and private collectors are directly affected by CITES rules, which govern such matters as acquisition and lending for exhibition.

CITES classifies endangered species in three categories or appendices according to degree of risk. Appendix I includes species immediately threatened with extinction; Appendix II includes species likely to become threatened if trade in them is not regulated; Appendix III includes species regulated internally by any signatory nation needing the co-operation of other nations to control trade. The rate of attrition in Appendix I is alarming: The U.S. Fish and Wildlife Service reclassified six North American animals as extinct in 1989.

Shipment of Appendix I species requires both import and export permits; Appendix I material taken from the sea outside any national jurisdiction requires an 'Introduction from the Sea' permit. Import of Appendix I material for commercial purposes is generally prohibited; permits are granted only when import or export will not be detrimental to survival of the species. Appendix II material does not require import permits, but export or Introduction from the Sea permits or re-export certificates are necessary. Export permits may be issued for any purpose if not detrimental to the species' survival; re-export certificates are required for export of material that was previously imported,

including raw material subsequently converted to manufactured goods. Appendix III species require one of three types of documents: 1) an export permit, issued for material originating in any country that listed the species on Appendix III (the U.S.A. lists no species under Appendix III); 2) a certificate of origin, issued by a country of origin other than a listing country (that is, by a country in which the species is not threatened); 3) a re-export certificate issued for previously imported material.

The number of affected species and of signatory nations will grow; Bulgaria, Mexico, Namibia and Uganda ratified CITES in 1991. However, sporadic political pressure to ease restrictions may be expected, for example from the five countries, Botswana, Malawi, South Africa, Zambia and Zimbabwe, that despite their CITES ratification have refused to ban trade in raw ivory. International protection of whales and other marine life also remains contentious, partly due to inadequate animal population statistics.

Less easy to understand than a ban on killing are restrictions on transporting finished goods, even antiques, containing materials from endangered species. CITES regulations may at first appear nonsensical insofar as they inhibit (but do not necessarily prohibit) international movement of musical instruments for cultural purposes. Nevertheless, the underlying objective, to change attitudes and preserve disappearing species, must be recognized as paramount. Museums can challenge or seek to refine aspects of CITES regulations, but may not subvert their purpose.

Current embargoes govern transit of whole specimens or recognizable parts and derivatives (excluding products of some trees), both for commercial and non-commercial purposes including museum acquisition and exhibition. Objects incorporating any amount of these materials, regardless of age, ownership and provenance, may be confiscated by customs agents if proper permits have not been obtained. Furthermore, traffic in an unthreatened or extinct species can be prohibited if material from this species (for example, mammoth ivory) so closely resembles material from an endangered one that enforcement personnel cannot tell the difference. When material from the endangered species might be sold or transported illegally under the guise of the practically indistinguishable unthreatened one, both may be listed. In view of this danger, Sotheby's cautions potential purchasers in these terms:

> 'Items made of or incorporating animal material such as ivory; whale bone; tortoiseshell etc., irrespective of age or value, require a specific licence from the Department of The Environment, prior to exportation. Sotheby's suggests that buyers check their local government department regarding the importation of such items.'

Different pre- and post-Convention categories govern transit of material obtained before or after its species was listed. No import permit is required even for Appendix I material that has a valid pre-Convention certificate. Material from captive-bred or artificially propagated sources requires other special certificates.

Certificates of exemption may be granted for international shipment of demonstrably old material, but the burden of proving age rests on the applicant, who may be required to provide scientific documentation. Recently made objects and recent repairwork utilizing old material are not automatically exempted. Even if an object is allowed to leave one country legally, it may not be admitted by another or readmitted to the first country without a separate permit or certificate.

Penalties for evasion, including fines and seizure of illicit shipments, can be severe and irremediable;

at the least, exhibition schedules and insurance coverage can be seriously disrupted by a customs investigation. Much depends on the mood and rigor of individual inspectors, who may be overzealous if provoked, though they often overlook small, unostentatious bits of regulated material used for example in violin bows. Though loopholes exist, it is best to offer well-documented declarations and not to try to evade inspection, as doing otherwise can raise suspicions and jeopardize future official co-operation with one's institution and its customs broker. Museum registrars should therefore thoroughly vet all international shipments in advance for the presence of embargoed materials, taking special care with exotic items that may incorporate feathers, insect parts, shells, furs and so on. Shipping containers must be clearly labelled with their contents, and at least 72 hours' prior notice to inspectors of a shipment's arrival is recommended.

In addition to CITES, stringent domestic laws also regulate some species. Crows, for example, although generally plentiful and sometimes a nuisance, cannot be hunted legally in most parts of the United States; consequently quill for harpsichord plectra is often in short supply. Species regulated by the U.S.A. are listed in the Endangered Species Act of 1973 and the Endangered Species Conservation Act of 1969; other relevant U.S. laws include the African Elephant Conservation Act, Marine Mammal Protection Act, Migratory Bird Treaty Act, Eagle Protection Act, and Lacey Act. Jurisdiction under these acts is shared by the Fish & Wildlife Service and the National Marine Fisheries Service. Domestic regulations can be complicated; for example, within the U.S.A. some normally prohibited commerce may be permitted under special circumstances, but according to section 17.52 of the applicable regulations, 'The permit for activities involving interstate commerce of plants must be obtained by the seller; in the case of wildlife [meaning animals], the permit must be obtained by the buyer.' Ignorance of confusing laws and regulations does not excuse violators.

The concerns discussed above raise serious issues for CIMCIM. As museum professionals, we are obliged to furnish accurate information about our holdings, and most of us encourage faithful reproduction of important instruments originally made with now-regulated materials. But museums also function in a wider sense to preserve and foster respect for our shared heritage and environment; therefore our activities with regard to treatment of endangered species should be models of ethical conduct. So, we seemingly face a conflict between the demands of 'authenticity' and the need to preserve disappearing organisms and whole biosystems.

Museums that encourage copying of instruments from their collections commonly provide technical drawings and other information identifying original materials. These descriptions may seem to imply that, in order to be valid, replicas must be made of the same substances as the originals. It is advisable, therefore, that technical drawings, data sheets, etc., carry a notice warning makers of pertinent regulations, and advising that substitutes be employed where necessary. Current laws do not prohibit craftsmen from using material that has been legally obtained, but because it is usually impossible to confirm that hunters or harvesters acted legally, new raw material is best avoided.

Restoration and replication necessarily involve compromise. In regard to materials, compromise can most readily be effected in decorative elements, where visually equivalent substitutes (such as synthetic ivory, mother-of-pearl, abalone, buffalo horn, and tortoise shell) are already commonplace. Tactile, acoustical, and structural aspects present greater problems, although very few circumstances demand a regulated material to achieve a particular sound or property. Yamaha's most recent formulation of casein-based Ivorite, for example, overcomes most objections to synthetic keyboard plating. Tropical hardwoods do, however, represent substances whose density and texture are hard to replicate and may indeed affect sound and response, as in woodwinds. Technical problems like these can be solved; after all, substitutes exist for living human blood and skin.

Developing a synthetic substitute often leads to fuller analysis of the traditional substance, and for that reason alone substitution may be worth pursuing. Substitutes may prove superior in some respects, such as durability. Many timpanists actually prefer the stability and consistency of synthetic drum heads, and most guitarists prefer nylon strings to gut.

We have no need here to restate the truism that the pure original state of an old instrument cannot be recovered by any means, and may not even be knowable. In any case, because no two pieces of wood are identical, no one reasonably expects a violin repair or replica, for example, to be literally indistinguishable from the original upon close scrutiny. Conservators and curators, at least, would not wish otherwise, since we are obliged to make such distinctions.

It is not the function of curators and conservators to remake the past, but rather to preserve and interpret important aspects of it. To be effective, interpretation - meaning education - must address the needs of our visitors, especially young people, who must learn that not all that went before can or should be done in like manner today. Just because now-endangered species were once exploited for the sake of luxury and commercial gain, we need not continue this harmful practice today when conditions are different. This attitude implies no disrespect for the past. Simply put, human behavior must adjust to contemporary reality if we are to survive as a healthy community inhabiting a world rich in genetic diversity.

Because the potential benefits of endangered species and habitats to humankind are incalculable, we have no right to allow their extinction merely to feed today's fashion and vanity. Counter-argument based on alleged aesthetic superiority of 'authentic' materials versus substitutes is ultimately unconvincing because subjective. Nevertheless, we would do well to define better the effective properties of traditional materials as a first step towards developing adequate substitutes. Precisely what qualities of various materials underlie their putative superiority, or do makers use them only out of habit ? Can the ear distinguish among them or are their virtues chiefly psychological, as in many ritual instruments ?

I have argued that museums are not 'ivory towers' that stand apart from worldly concerns. As educational institutions we undertake a responsibility not only to preserve artifacts but to develop and impart knowledge about our shared environment, with a view toward enhancing appreciation and respect. How best to do this is, in my view, a far more important issue than whether a particular historic instrument is replicated or restored with real ivory or with cast polyester resin.

The issue as it concerns endangered species rests not solely on ethics and responsibility, but also on practicality. Synthetics are often cheaper, more stable and more durable than the natural materials they replace; these advantages need to be considered especially in situations where historic instruments or replicas are used in performance. But where it is felt that traditional, regulated materials are necessary, perhaps an informal, nonprofit supply network could function without promoting commercial depredation. A museum stocking more ebony that it could ever use might trade or give some of that supply to a less fortunate institution. The harpsichordist Thurston Dart had a private arrangement with the London Zoo, which often enough provided him with naturally shed feathers; connoisseurs will note, however, that only certain feathers provide the best quills and then only in seasons when these feathers are strongest. Pressure on wild birds therefore remains relentless. In any sharing network, great care must be taken not to encourage illegal trade inadvertently by too widely advertising a need, because whenever profit provides a motive, laws will be subverted.

Curators must further decide how best to display instruments incorporating prohibited materials so

as not to encourage or legitimize their use. A descriptive label might include the remark that 'making flutes of elephant ivory is no longer condoned.' Curators can make virtue of necessity by proclaiming that 'missing ivory key covers have been replaced by synthetic ivory,' and thus enlist public sympathy for wildlife while at the same time honestly defining the limits of authenticity.

My personal views and suggestions are intended to provoke discussion, but are not definitive and do not necessarily express the position of the Metropolitan Museum of Art. Information about synthetic ivory, horn, tortoise shell, mother-of-pearl, etc., can be obtained from, among others, GPS Agencies (Mr. Roy Stevens), Units 3 & 3a, Hambrook Business Centre, Cheesman's Lane, Hambrook, Chichester, West Sussex, PO18 8UE, England.

The Clavicytherium (c 1480) and its 'copy' in the Royal College of Music Museum, London

Elizabeth Wells, The Royal College of Music Museum, London

The late fifteenth-century clavicytherium in the Donaldson collection (formerly in the Contarini & Correr collections in Venice) appears to be the earliest surviving stringed keyboard instrument; the 'copy', commissioned in 1970 and completed in 1973, is probably one of the first to be commissioned by a Museum. This paper will give a brief description and history of the original, followed by a survey of the building of the reconstruction, the publication of a detailed plan after radiographing the original, the research and developments that have followed and the conclusions that may be drawn.

Relatively little attention has been given to the earliest stages of the development of the harpsichord and remarkably little in most general surveys to this important and fascinating instrument. When I first began to compile a catalogue of the collection in 1964, virtually no documentation on the clavicytherium existed apart from the published references (some rather inaccurate) in Hipkins and Gibb, James, Russell and Hirt[1] and the brief notes written by Dr Karl Geiringer for the College in 1940 (his entry read: 'a beautiful instrument in a quite hopeless state of preservation'). The collection, including the clavicytherium, was poorly displayed and conserved; the most urgent task was to fumigate the collection against woodworm and then to raise sufficient funding to rehouse it. Thanks to the generosity of Trusts and individuals a new air-conditioned museum was built and opened in April 1970.

Meanwhile, a thorough investigation of the clavicytherium was being carried out. It transpired that it was probably made in South Germany, circa 1480: inscriptions and manuscript fragments inside the instrument indicate a late fifteenth-century German-speaking builder who may have worked in Ulm. The decoration, the short wide keys and small compass (40 notes) also suggest this early date. Much of the Italianate landscape in the recess is missing but the surviving rose, a miniature Gothic window carved in wood with painted and gilded paper behind, is exquisite and the recess and soundboard are surrounded with carved and painted Gothic tracery. The paintings on the case are later and the keys were lengthened, rather crudely, by the addition of new key tops and fronts, possibly when the compass was altered. The action is simple and efficient: the keys are joined by vertical 'stickers' to the jacks and they return by gravity. Preserved in the Contarini and Correr collections near Venice from the late seventeenth century, the clavicytherium was sent to London for the International Inventions Exhibition in 1885, after which George Donaldson acquired it. Further information on the instrument has been published[2] or will be included in the catalogue of the keyboard instruments which we hope to publish.

Because of its significance and fragile worm-eaten state, restoration of the clavicytherium was out of the question. After consultation with conservationists, when differing solutions were proposed, I decided that consolidation should not be attempted; we should instead build as complete a record of the instrument as possible, to learn from it whatever we could whilst protecting the original from handling which it would not survive. So Derek Adlam was asked to construct a 'copy' (reconstruction would perhaps be a better word); he began measuring in November 1970, further photography was undertaken during his visits and the reconstruction (funded by a generous gift from Mr and Mrs Graham Carritt) was completed at Finchcocks under his direction by the firm of Adlam-Burnett. Delivered to the Museum in June 1973 on the day of its inaugural concert, the copy was launched by Derek Adlam; in addition to his eloquent playing of solo repertoire, he also accompanied John Elwes, at that time a student at the College. It has since been played in a number of broadcasts, Museum concerts and lecture recitals and is demonstrated regularly in tours of the collection and classes.

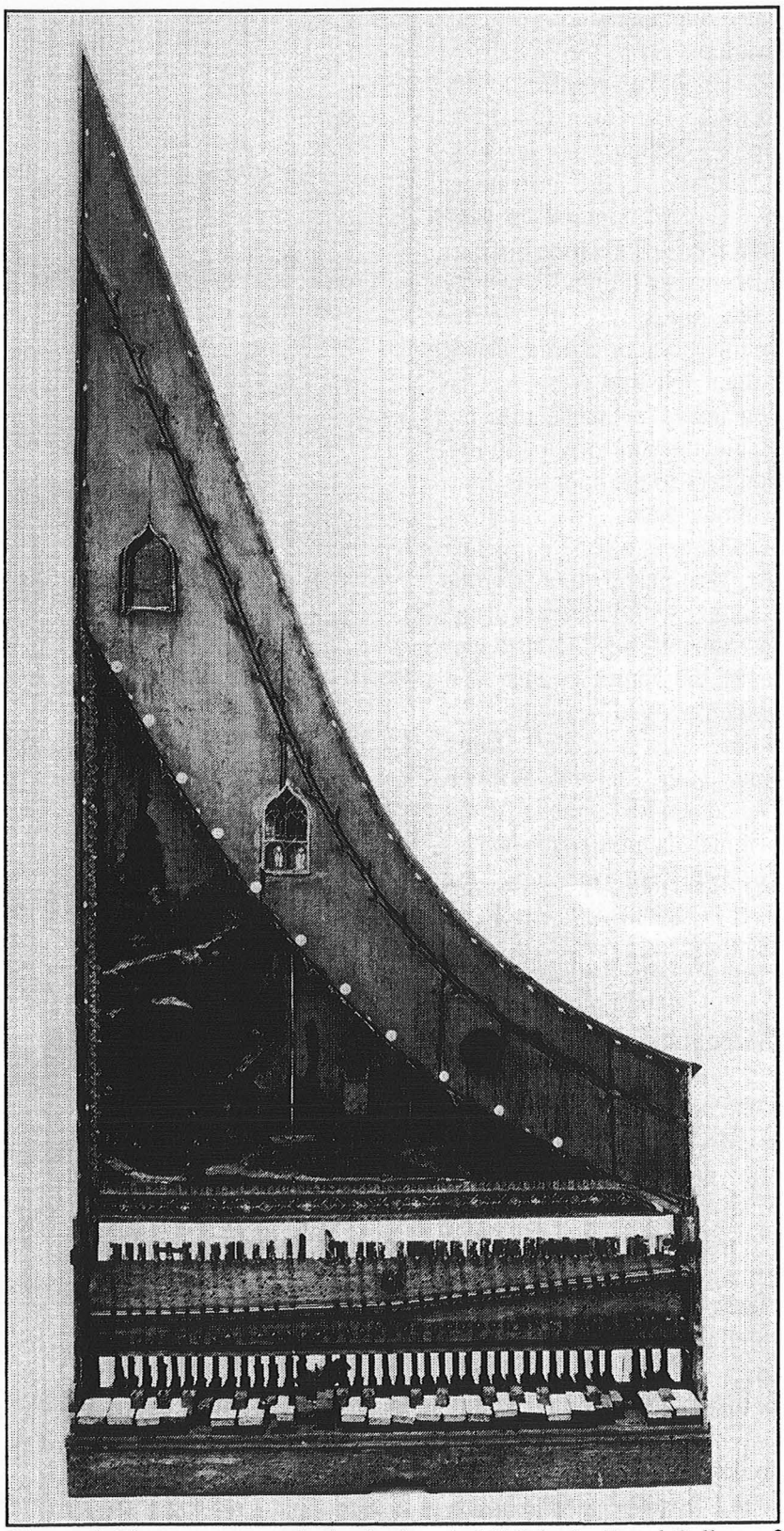

Figure 4 The anonymous clavicytherium (c 1480) in the Royal College of Music Museum

Although there are factors of which we cannot be sure, the copy has revealed a good deal about the physical and musi-

cal characteristics of the original. For the extensive contemporary repertoire (for example the Buxheim Organ Book), much of it song intabulations, the instrument is wholly appropriate and effective; the wide octave span makes it difficult to play later music with more counterpoint or chords. Derek Adlam felt that there was no conclusive evidence that the clavicytherium originally had dampers so the copy was built without them. The resulting resonance is a little confusing for the player and anyone standing within six feet of the instrument; beyond that distance the sound is clear and combines well with lute and voice. The Museum's copy was built before William Debenham had established the original compass so it was decided best to copy the present compass of E - g".

Further copies have been built by Derek Adlam and, after the publication of the drawing, by other makers too, some instruments having the original compass and at least one having dampers. The Museum's copy is tuned in a Pythagorean or meantone temperament according to the pieces being played and Mark Lindley and Mimi Waitzman have used it in Museum lectures discussing repertoire and temperaments[3]. We do not know the original pitch or string materials (the fragments on the original are mostly of yellow brass) but the copy has nonetheless

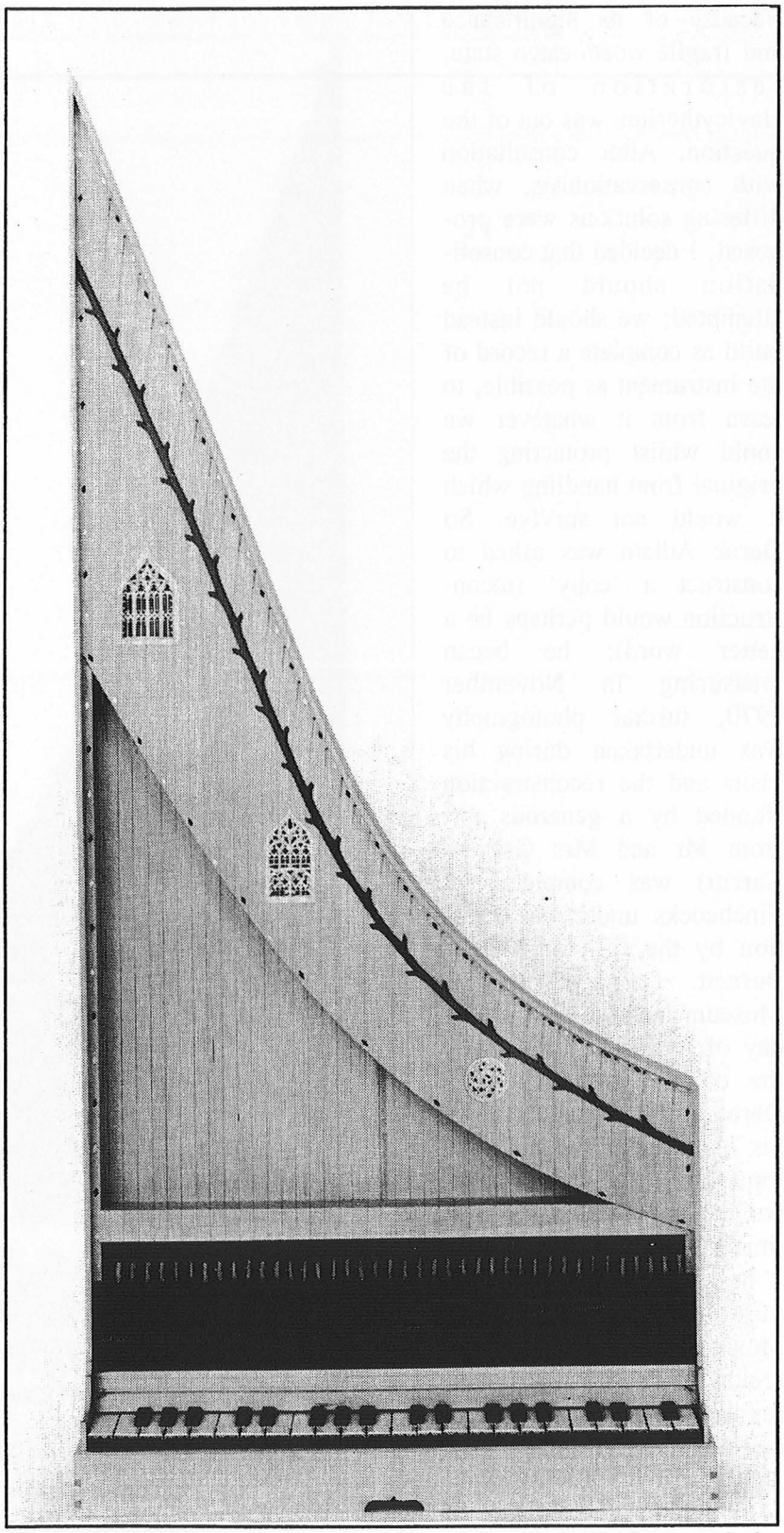

Figure 5 The Museum's reconstruction of the clavicytherium, made by Adlam-Burnett, 1973.

enabled players and listeners to come closer to this early repertoire.

In 1975 the original was radiographed so that a more detailed drawing by William Debenham could be prepared. John Barnes had previously proposed that the original compass was F-a", but this depended on there being a replacement balance rail and variable octave widths. The radiographs showed that only two balance pins had been moved: William Debenham then undertook a further prolonged study of the keys and eventually concluded that the original compass must have been E 'E♯' F G - g"[4]. Further information and corroboration of the date of origin has been gained from examination of inscriptions in ultra-violet light and from the National Gallery Scientific Department's examination of samples of blue and red paint by optical microscopy and spectrographic analysis with the laser microprobe (LMA). Several attempts to obtain a tree-ring dating of the back of the instrument have been made, so far without success.

There is constant pressure, especially in a conservatoire collection, to make historic musical instruments playable. I believe that the solution that we chose with the clavicytherium fulfils the aims, so often incompatible, of both conservation and education and would be the best course for many other instruments in the collection if space and funding could be found. Copies of important instruments such as the harpsichord by Trasuntino, 1531, and virginals by Celestini, 1593, would be particularly valuable. There is another earlier 'copy' in the Museum - the clavichord after Hass by Dolmetsch, commissioned by the Director, Sir George Grove, in 1894 so that RCM students could play and hear a clavichord. Besides being part of the history of the revival of early keyboard instruments, it is still invaluable since even now few visitors have heard a clavichord except in recordings. Three other 'copies' in the collection appear to have been made in the nineteenth century as fakes. Some years ago John Barnes made a copy of the Museum's clavichord by Johann Bohak, formerly owned by Haydn, when investigating the instrument for the Museum.[5] In this instance it was felt that as some of the original sound-producing parts were missing a Museum copy should not yet be commissioned, though John Barnes's drawing has recently been published by the Museum; if another clavichord by Bohak with original tangents and bridge that could be copied were to be found, a more accurate Museum copy would then become possible.

The exact 'copy' is an ideal that cannot be fully realised: it is like the perfect performance for which every musician strives. And every copy of the same model by the same maker will vary and have its own 'life' and distinct character. Instrument museums should nonetheless strive to attain this ideal whenever appropriate to protect original material and to illuminate and inform.

NOTES

1. A J Hipkins, *Musical Instruments, Historic, Rare and Unique* ... illustrated by ... William Gibb [Edinburgh, 1888] p.13 and plate VI.
   A J Hipkins, *A Description and History of the Pianoforte and of the older Keyboard Stringed Instruments* [London and New York, 1896], p.73.
   P James, *Early Keyboard Instruments* [London, 1930], plate XXXIII.
   F J Hirt, *Meisterwerke des Klavierbaus* [Olten, 1955], p.292.

2. Nicholas Meeùs, 'La Naissance de l'octave courte et ses differentes formes au 16e siècle'. [Université Catholique de Louvain, 1971].
   J H Van Der Meer, 'A Contribution to the History of the Clavicytherium', *Early Music*, **VI**, 1978, p.255; **VII**, 1979, p.140.
   Elizabeth Wells, 'An Early Stringed Keyboard Instrument: The Clavicytherium in the

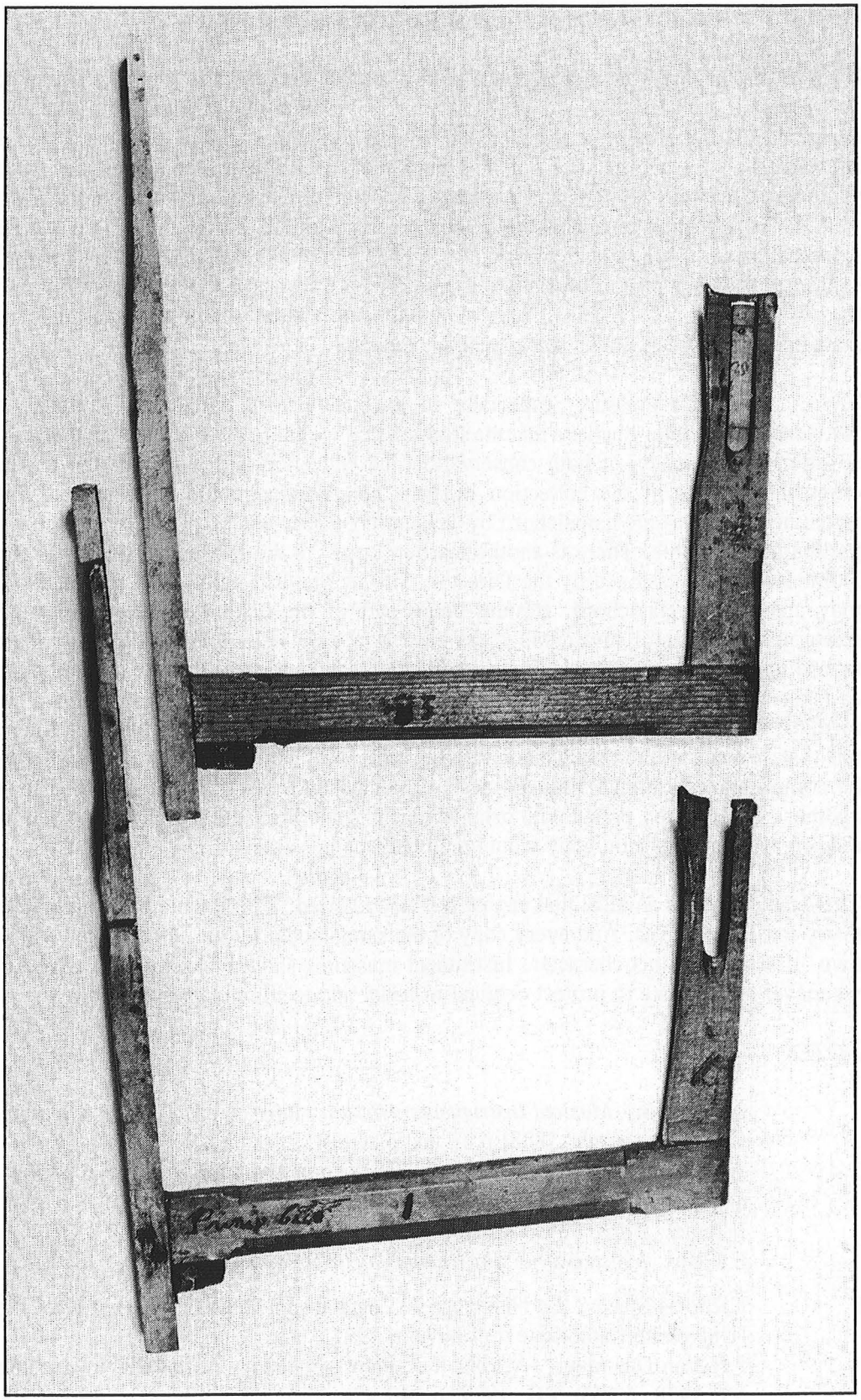

Figure 6 Profiles of two keys, one being the lowest of the present compass.

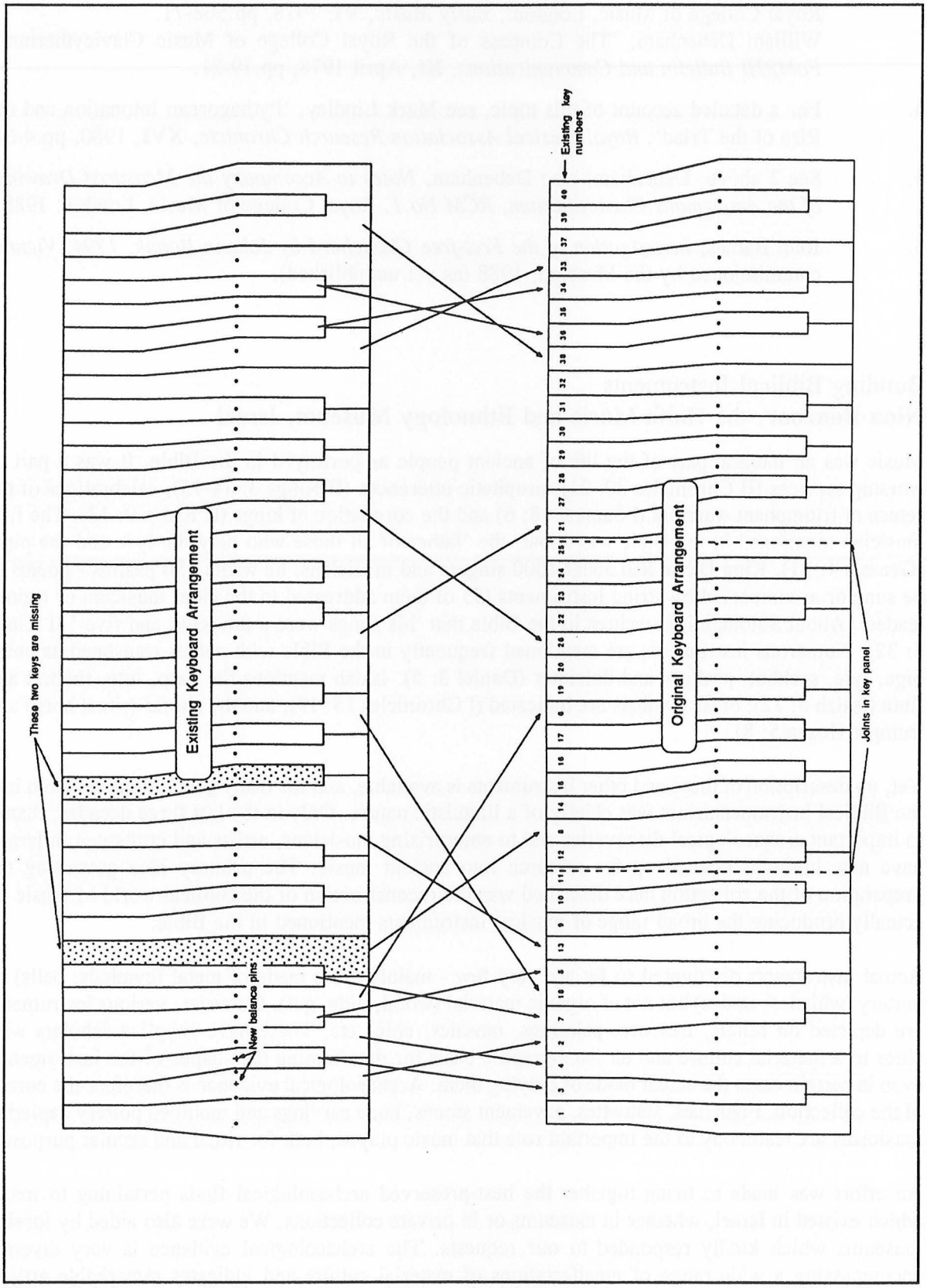

Figure 7 Diagram by William Debenham showing original and existing arrangements of the keys.

Royal College of Music, London', *Early Music*, **VI**, 1978, pp.568-71.
William Debenham, 'The Compass of the Royal College of Music Clavicytherium', *FoMRHI Bulletin and Communications*, **XI**, April 1978, pp.19-21.

3. For a detailed account of this topic, see Mark Lindley, 'Pythagorean Intonation and the Rise of the Triad', *Royal Musical Association Research Chronicle*, **XVI**, 1980, pp.4-61.

4. See 2 above, Debenham; also Debenham, *Notes to Accompany the Measured Drawings of the Anonymous Clavicytherium, RCM No 1*. Royal College of Music, London: 1988.

5. John Barnes, *Investigation of the Fret-free Clavichord by Johann Bohak, 1794, Vienna*, commissioned by the Museum, 1988 (as yet unpublished).

Building Biblical Instruments

Nina Benzoor, the Haifa Music and Ethnology Museum, Israel

Music was an integral part of the life of ancient people as portrayed in the Bible. It was a part of worship services (II Chronicles 30: 21), prophetic utterances (II Kings 3: 14-15), celebrations of the return of triumphant warriors (I Samuel 18: 6) and the coronation of kings (II Kings 9: 13). The first musician mentioned in the Bible was Jubal, the 'father of all those who play the lyre and the pipe' (Genesis 4: 21). King David had about 4000 singers and musicians; he wrote 150 psalms - poems to be sung or accompanied by string instruments (55 of them addressed to the chief musician or trained leader). About Solomon it is written in the Bible that 'his songs were a thousand and five ' (I Kings 4: 32). Numerous instruments are mentioned frequently in the Bible with names translated as horn, pipe, lyre, sackbut, psaltery and dulcimer (Daniel 3: 5). Isaiah mentions the harp, lute, timbrel and flute (Isaiah 5: 12); brass cymbals are indicated (I Chronicles 15: 19), and the shofar (ritual horn) and trumpet Hosea 5: 8).

Yet, no description of these and other instruments is available, and for many generations research into the Biblical instrumentarium was chiefly of a linguistic nature. Only in the last three decades, thanks to important archaeological discoveries and to enterprising musicians, artists and craftsmen in Israel, have new horizons opened up for research into ancient music. The primary idea governing the preparation of the collection here described was the reconstruction of the Biblical world of music by actually producing the broad range of musical instruments mentioned in the Bible.

Actual instruments discovered so far are very few - mainly those made of metal (cymbals, bells) or pottery (whistles, rattles) but not of organic material (wood, hide, gut). However, various instruments are depicted on reliefs, frescoes, paintings, mosaics, coins etc. These have supplied scholars with clues to a material culture and an iconographic basis for determining the shapes of the instruments; even in certain cases the actual mode of playing them. Archaeological evidence is therefore the corner of the collection. Figurines, statuettes, pavement stones, bone carvings and moulded pottery depicting musicians are testimony to the important role that music played, both for ritual and secular purposes.

An effort was made to bring together the best-preserved archaeological finds pertaining to music which existed in Israel, whether in museums or in private collections. We were also aided by foreign museums which kindly responded to our requests. The archaeological evidence is very diverse, encompassing a wide range of manifestations of material culture and indicates remarkable artistic creativity. When reconstructing the instruments, many complex problems confronted the large team

of experts - musicians, artists and craftsmen. There had to be a thorough examination of the source material, determination of the materials to be used, unravelling the mysteries of the structure, dimensions, tuning, and a host of other matters. After all, the shape of a *kinnor* (lyre) or a *nevel* (harp) on a coin or a vase does not reveal to us the material of which it is made, which could be wood of some kind, hide or gourd, what kind of strings, or the devices for fixing and tensioning the strings. The known is far out-weighed by the unknown.

Hence, certain instruments were built in several different models in an attempt to achieve maximum authenticity. It is clear, however, that quite a few problems have remained without a satisfactory solution. So far, this experiment in building biblical instruments has remained unique. There is still much to be done in the future. Until real evidence of the exact details of instruments is found at excavations, the reconstructions serve as the only estimate of how the biblical people produced their sounds.

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