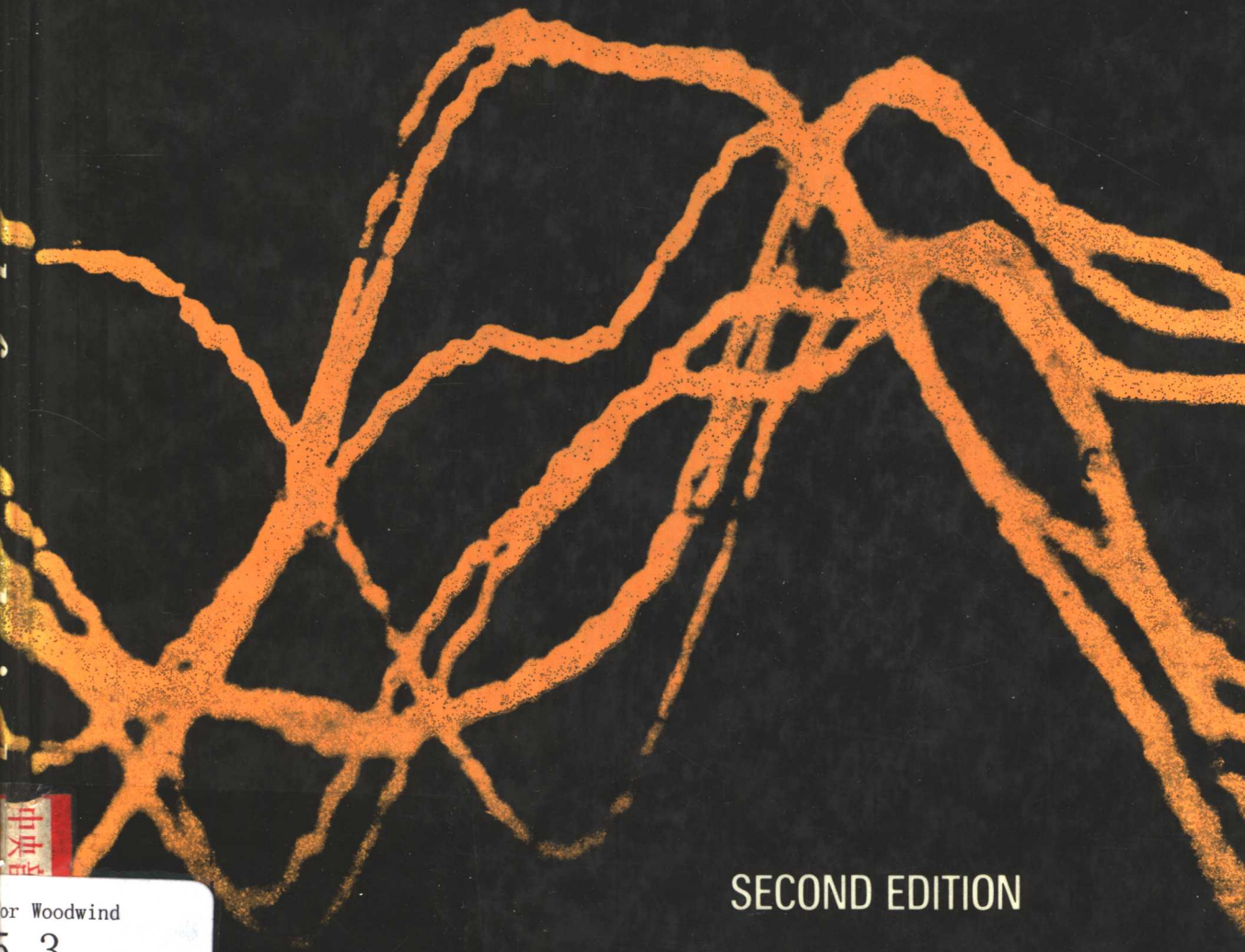
new sounds for woodwind

BRUNO BARTOLOZ



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acknowledgements

My greatest thanks are due to Sergio Penazzi, without whose help this book could never have been written. Professor Penazzi, who is first bassoon player at the Teatro alla Scala and teacher at the Milan Conservatoire, showed me how multiple sounds could be played on the bassoon as long ago as 1960, and since then has given me full collaboration in evolving new techniques. Later, Lawrence Singer confirmed that similar results are possible with oboe and also conducted experiments in methods of quarter-tone production. The validity of these techniques for all other woodwind instruments was then confirmed with the help of players in the Maggio Musicale Orchestra of Florence.

My most sincere thanks are therefore due to Sergio Penazzi and Lawrence Singer for their untiring assistance and collaboration, and for those players of the Maggio Musicale Orchestra who helped me so much, particularly the flautist Pierluigi Mencarelli and the clarinettist Detalmo Corneti. Finally, I would like to thank Reginald Smith Brindle for his precious contribution in preparing this book in an original version in English.

For the second edition, while expressing my profound thanks once again to the eminent instrumentalists Sergio Penazzi, Lawrence Singer, Pierluigi Mencarelli, and Detalmo Corneti, I wish also to express my gratitude to the clarinettist Giuseppe Garbarino for the most invaluable co-operation he gave me in carrying out further instrumental researches and in formulating the relevant technical details set out in this book. And I wish once more to acknowledge the decisive encouragement and assistance I have received from Reginald Smith Brindle from the earliest beginnings up to the present.

BRUNO BARTOLOZZI

editor's note

Bruno Bartolozzi died while this second edition was in proof. The numerous detailed changes since the original publication were, however, mostly made during his lifetime, and the final text is believed to conform with his intentions.

REGINALD SMITH BRINDLE

contents

1 *preliminary observations*

Wenn es Wirklichkeitssinn gibt, muss es auch Moglichkeitssinn geben. ROBERT MUSIL

The event which distinguishes the present musical age is the discovery of the means of producing music electronically. A new period has begun in which traditional instruments are no longer the uncontested protagonists of the musical scene. Orchestral instruments are now set against electronic devices, such as elaborators, computers, synthesizers, etc., capable of producing sounds which for structural reasons they themselves cannot. These devices, besides being able to produce the whole range of sounds that can be achieved by conventional instruments, are also able to produce a vast number of other sounds, in practice the whole range of frequencies that is theoretically possible. This development has been of enormous musical importance, and has had a profound effect on the life of the instruments themselves. Contrary to some prophecies of their gradual abandonment they are receiving instead a great impetus of technical development, largely stimulated by the example set by electronic devices. In fact we owe to electronic music the revelation of a world of sounds unknown to instrumental music, at the moment when traditional instruments were considered to have reached the limits of their technical possibilities. This revelation has helped greatly to develop a musical situation so much in ferment as it is today, in which the present progress of instruments seems perfectly natural. For this reason our own instrumental researches may be seen as a not unfruitful labour.

The field of research that has been opened up with *New Sounds for Woodwind* is vast, so much so that it was clearly not possible to explore it all in a single investigation. This second edition of the book therefore has the aim of providing more information about the technical possibilities that have already been discussed, and of illus-

trating others, so as to facilitate the completion of the research and hence the introduction into instrumental practice of the sounds resulting from the newly-acquired techniques. In trying to attain this goal we shall combine the experience gained from preparing four tutors[1] with the observations and comments which have been made to us by numerous instrumentalists and composers.

It first became clear that further developments in woodwind techniques can be achieved when it was found that certain new playing techniques led to effects of unexpected novelty. Since then a substantial vocabulary of new sounds has been formed which can enrich and amplify that which already exists.

Researches began with a discovery of fundamental importance, that woodwind instruments—contrary to general belief—can produce multiple sounds. Furthermore, these multiple sounds can be organized into polyphonic writing.[2] Such a possibility has so far been completely ignored both in orthodox instrumental usage and by those who have published treatises on the acoustical characteristics of wind instruments. This possibility of producing a rich vocabulary of multiple sounds means that up till now only a part (and perhaps not the most interesting part) of the real resources of the woodwind have been exploited.

Such a discovery reveals that the real capabilities of these instruments are twofold—both monophonic and multiphonic (and not, as has always been supposed, only monophonic)—and naturally technical developments will now turn towards a more complete exploitation of these resources.

[1] For flute by Pierluigi Mencarelli; for oboe by Lawrence Singer; for clarinet by Giuseppe Garbarino; for bassoon by Sergio Penazzi—Edizioni Suvini Zerboni, Milan.

[2] 'Polyphony', as here used, is meant not so much in the academic sense of strict contrapuntal usage, but in a wider sense signifying 'many-voiced' sounds organized in such a way as to be of musical significance.

Elsewhere in this book the hybrid term 'multiphonic' has had to be coined in order to describe the general concept of multiple sounds produced by woodwind (as opposed to their normal production of single sounds). The author always refers to 'polyphonic' possibilities in the original Italian, but it has been felt best to avoid this usage (with its inference of organized voice writing), even if an ungainly-looking substitute has had to be resorted to. (Ed.)

As in this treatise there is no proposal to modify the existing structure of woodwind instruments—a structure 'which science itself holds to be so excellent as to discourage any modifications'[1]—it would be legitimate to ask why traditional techniques have not included all those resources which instruments really have to offer. How is it that, until today, possibilities which have always existed, have been so long ignored? How is it that instrumental techniques have become fixed in a pattern which does not allow any results except those actually in conventional use? The complex issues behind these questions are such that straightforward, irrefutable answers cannot be given. However, suppositions can be made which must be fairly near the truth of the matter.

On examining the historical development of woodwind instruments, there appear to be two main reasons which have determined traditional techniques. One is that the structural evolution of instruments has been derived by exclusively empirical methods, the other reason has been the musical requirements of past epochs. In fact, as both instrument-makers and performers have not followed (or have not been able to follow) scientific directives indicating the ends to pursue, their efforts have been concentrated on a single objective—the emission of single sounds of maximum timbric homogeneity throughout the range of instruments.[2] The objective has therefore been not one of exploiting the characteristic possibilities of each instrument but of satisfying the musical requirements of each successive epoch. If this empirical procedure has produced excellent results from the structural point of view, it is evident that the same cannot be said as regards the development of technique, which has become rigidly standardized in one method aimed at the most efficient achievement of the original objective—single sounds of homogeneous timbre.

However, in the development of woodwind instruments one

[1] Ottavio Tiby, *Acustica Musicale* (Palermo, 1933), p. 177.

[2] We refer to 'single' sounds here and later on knowing full well that instruments do not produce single sounds but a principal tone and also additional partial tones which give the sound its particular timbre. However, we are accustomed to hear these as single sounds, and we will continue to refer to them as such in order to differentiate them from multiple sounds which are indubitably heard as combinations of different notes. (Ed.)

scientific approach of no small importance has been used, that of taking advantage of the acoustic principle on which the 'mixed' system of sound production is based. This 'mixed' system comprises a range of *fundamental* tones in the lower register of instruments and their various *harmonics* from which higher notes are derived. The upper registers of woodwind instruments are completed by using partial tones from the harmonic series whose wavelengths are integral fractions of those of the various fundamentals ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$).[1] These partial tones are harmonics at the octave, twelfth, double octave, seventeenth, and nineteenth respectively, and are used in this order to form the upper registers—an order which is *pre-established and never altered*. Such a procedure, though excellent as regards satisfying the traditional demand for single sounds of homogeneous timbre, is indeed something of an obstacle when we wish to obtain those other effects which these instruments can really produce.

In fact, the use of a single pre-established order of harmonics in the 'mixed' system of sound production has led to the establishment of a single system of fingerings caused by the selection—from a large number of alternative fingerings—of only those which are most suitable to ensure good intonation and the maximum of timbric unity throughout the range of each instrument. Admittedly, a limited number of alternative fingerings have been established with a view to facilitating certain passages or (in the upper register) the emission of difficult notes, but the general intention has been one of standardization and the elimination of alternatives. Similarly, the embouchure and blowing techniques have also been standardized so as to ensure timbric uniformity, resulting in an unvaried, standard type of performing technique.

These are the causes which have made traditional techniques become a closed system, a system which deliberately excludes any pos-

[1] These are the partial tones used in a cylindrical tube open at both ends (the flute) or a tapered cone effectively closed at one end (the oboe and bassoon). With the clarinet, however, which is a cylindrical tube effectively closed at one end, only odd-numbered partials are available (i.e. $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{7}$, and $\frac{1}{9}$). These represent harmonics at the twelfth, seventeenth, twenty-first, and twenty-third respectively, notes which bear relationships of one octave and a fifth, and two octaves and a third, seventh, and ninth with the fundamental. (Ed.)

sibility which does not contribute to its own objectives, and thereby eliminates from the outset so many other latent possibilities which we are only now discovering. This situation has been quite satisfactory as long as musical requirements were limited to the purity and 'beauty' of sound obtained through uniformity of timbre. But such ideals have become more and more inadequate to the needs of contemporary music. For while it is legitimate to disregard that maltreatment of instruments which occurs in some kinds of 'artistic' manifestations, it is nevertheless true that contemporary music requires means of expression which can no longer be exclusively provided by 'beauty' of sound or 'tunefulness'. In fact, as there are no longer 'false' notes now that the electronic sound spectograph has allowed the frequency of any sound to be determined, so there are no longer sounds which are 'ugly', 'unpleasant', 'hard', etc. Rather are there only sound phenomena which are useful in proportion to how much they lend themselves to organized musical usage.

It is precisely in this direction that those more adventurous instrumentalists have directed their efforts in their search for new sounds designed to satisfy the needs of contemporary composers.

As became apparent from the beginning of our investigations, we can now confirm that the most fruitful field for research lies in the following instrumental possibilities: (*a*) the suitability of woodwind for the creation of single sounds with marked difference of timbre; (*b*) the ability of these instruments to play music which contains smaller intervals than those contained in the tempered chromatic scale; (*c*) the suitability of each instrument for creating polyphony, that is, not only the emission of very varied combinations of chords, but the execution of a true and proper instrumental polyphony.

Other possibilities will be discussed later, but from the above alone it is evident that there exists a well-founded escape route from the restrictions of the fixed traditional techniques. This route may be followed by examining all the means of sound production *de novo*, without setting any limits to our objectives, and only aiming at exploiting whatever sound phenomena are discovered, in a musicianly manner. The objective of this book is therefore one of illustrating the technical development of the real resources of woodwind, as well

as providing a large number of musical illustrations of all the technical possibilities discussed, to allow the immediate use of the resulting new sounds. I must confirm that the results of investigations have been arrived at only by practical experiment and not through scientific research. (This is inevitable, for it would seem that at the moment scientific research into woodwind sound-phenomena lags very much behind the practice which this treatise proposes. To have attempted scientific researches would have slowed down these investigations very drastically, though it is to be hoped that in time science will furnish explanations for many perplexing phenomena.) Given the empirical nature of the researches, it is therefore proposed to use only conventional musical and instrumental terminology in this book. Due to the lack of scientific principles and because of the complexity and novelty of the subject-matter, it would be absurd to pretend to establish irrefutable theories. On the contrary, where theories are advanced, their purpose is rather that of permitting an immediate practical application of general principles.

In order that the reader may be introduced to the more complex subject of multiple sounds by easy steps which begin with the study of single sounds, the treatment of monophonic possibilities has at first been separated from multiphonic phenomena. We will therefore keep to the following scheme: the second chapter will deal with monophonic possibilities, the third with multiple sounds and polyphony and the fourth will demonstrate the whole of these possibilities, monophonic and multiphonic, brought together in one unified technique.

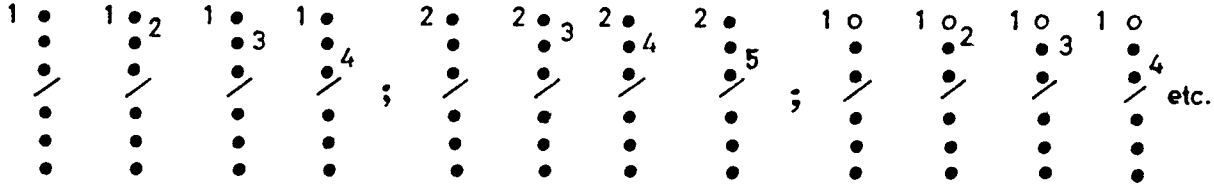
Rather than deal with woodwind instruments of every kind, it has been thought sufficient to deal only with the main representatives of each group—flute, oboe, clarinet, and bassoon. The technical possibilities of all the others can be logically deduced from following that of the four main types.

Before examining *de novo* the monophonic possibilities of woodwind instruments it is necessary to establish some rules of a general nature. It is necessary to specify (1) what is the real nature and quantity of fingerings available so as to establish a method of investigation, (2) how the monophonic and multiphonic possibilities are distributed in the

compass of instruments, (3) how to adapt the embouchure and method of blowing to the needs of the new techniques.

Fingerings available

Theoretically, the number of possible fingerings available is enormous, for it is the result of all the possible combinations of finger and thumb holes multiplied by all the possible combinations of chromatic keys. For example:



(*N.B.*—The fingering systems used in this treatise are the Boehm Systems for the flute and clarinet, the Conservatory System for the oboe and the Heckel System for the bassoon. These are indicated on the diagrams of instruments included as a foldout at the end of the book.)

In theory this provides many millions of possible fingerings, but in practice many of them give an identical sound result. Nevertheless, the number of fingerings is so great as to discourage at the outset any method which contemplates the investigation of every available fingering one by one. The problem should rather be limited to devising the best way of selecting fingerings for any specific purpose, in which case the most practical procedure would be as follows:

a. decide on a limited technical objective which our knowledge of the monophonic and multiphonic possibilities of any instrument may suggest;

b. devise the method of selection of suitable fingerings;

c. adapt the embouchure and mode of blowing as necessary;

d. classify the sound material obtained.

Distribution of monophonic and multiphonic characteristics throughout the compass of instruments

It must be first established at which point in the compass of instruments the same sound can be emitted with tone-colours of distinctly different quality. In other words, the lowest note from which it is possible to generate the same fundamental soundwave with different percentages of its various upper partials. This begins at the point of the compass in which the same sound can be played with different fingerings[1] and is at the low G♯ for the flute, low D♯ on the oboe, low A (as written) on the clarinet and low C on the bassoon. Below these notes, it is impossible to play sounds with more than one fingering, but higher up, alternative fingerings are available, often in very abundant quantity.

It is from this same point that instruments are able to emit combinations of chords containing from two to six sounds, that is, they can generate simultaneously a number of frequencies of vibration the lowest of which is not necessarily a simple fraction of all the others.[2] Particularly worthy of note is the clarinet, which, in contrast to the other instruments, can form chordal combinations even from the lowest fundamental.

We can therefore establish—even if only by practical experiment—that the dual capacity (monophonic/multiphonic) of woodwind instruments begins at the notes specified above, continuing uninterruptedly throughout the rest of the compass, except for the clarinet as mentioned. Virtually the whole range of instruments is available, except for the lowest fundamentals indicated. This does not exclude the possibility that all instruments (particularly the oboe and bassoon) may have multiphonic resources from the lowest fundamentals, but, as it is preferable to consider only what has been achieved in practice, this eventuality must for the moment be shelved.

[1] These various fingerings naturally do not include those which merely use alternative *keys* which can be used by fingers of either hand to close the same hole (as the clarinet).

[2] If the lowest sound were a simple fraction of the frequencies of higher notes, we would have a sound combination comprising a fundamental and certain of its upper partials. This, in fact, is quite possible, as certain sounds can be created which include only major or minor chords. But more frequently the situation is much more complex and the lowest sound seems to bear little or no frequency relationship to the others.

LIST OF SIGNS USED TO INDICATE EMBOUCHURES, LIP PRESSURES, AIR PRESSURES, ETC.

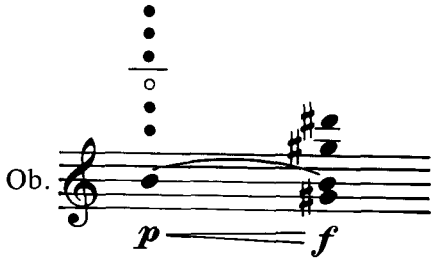
Lip pressures

○ = relaxed lip pressure
◒ = slightly relaxed lip pressure
● = very relaxed lip pressure[1]
□ = increased lip pressure
◪ = slightly increased lip pressure
■ = much increased lip pressure

Air pressures

N.Pr. = normal air pressure
M.Pr. = much pressure
P.Pr. = little pressure
A.Pr. = augment air pressure
D.Pr. = diminish air pressure

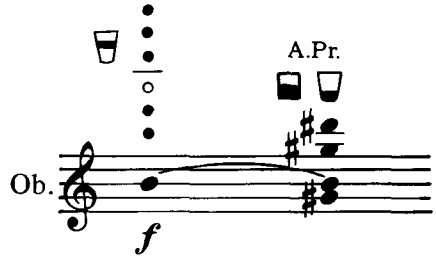
In general, where dynamic signs correspond to the blowing pressure required, eg.



there is no need to add specific indications for increased (or decreased) air pressure, as these are already implicit in the dynamic symbols

[1] In the case of the clarinet the inside of the lower lip should rest on the reed instead of on the teeth as in the normal lip position.

used. But special use of lip and air pressures may be required (and must be indicated) where the dynamics of the music do not imply any change, as, for example:



Embouchures (position of the lips on the reed)

For reed instruments, these are shown as follows:

At (or towards) the tip of the reed

At (or towards) the base of the reed

The sign ⤸ indicates that the instrument should be brought nearer the body so that the lower lip can press on the reed while the upper lip maintains a light pressure. The sign ⤹ indicates that the instrument should be brought upwards so that the upper lip can press on the reed while the lower lip maintains a light pressure. This way of increasing lip pressure is particularly useful with the clarinet. In the case of the flute the following signs indicate the various apertures of the lips and the position of the sound hole of the instrument:

○ Very wide—as playing in the low register
◒ Wide—as used in the middle register
● Not so wide—as used in the upper register
■ Very small aperture—as used in the upper register
⬓ Reduced aperture—as used in the middle register
□ Not so reduced aperture—as used in the low register

Sound-hole position

◯ Moving the hole outwards from the lips
⬭ Moving the hole towards the lips

These signs are virtually the same as those used for lip pressures with the reed instruments, in order to avoid the confusion of a large number of different signs. For a similar reason, when there is a normally obvious relationship between two factors—e.g. increased lip pressure and increased air pressure—one sign only will be used. This is equally valid for both the flute and reed instruments. In other cases, where lip and air pressure are in contrast to the normal usage (e.g. □ and M.Pr.), both signs have to be used.

In cases where normal playing conditions are obvious (or where adjustments are so minimal as to be readily foreseen by the player) no signs are used.

The symbol 'N.' is used to indicate a return to normal playing methods when otherwise it would not be obvious, and cancels out any previous special usage.

2 *monophonic possibilities*

Monophonic possibilities will now be investigated, establishing as a first objective the emission of sounds with the *maximum differentiation of timbre.*

PRINCIPAL SOUNDS AND SECONDARY SOUNDS

It has already been stated that woodwind instruments are the only ones which use a 'mixed' system of sound production (i.e. fundamental tones for the lower register and various natural harmonics of these for the upper registers). This means, amongst other things, that while the fundamental tones are based by construction on the tempered chromatic scale, the harmonics, having the intonation of upper partials, will have a slightly different tuning—that of the natural scale. But it is not on these discrepancies of intonation that we must focus our attention, but on the impossibility, with this traditional 'mixed' system of sound production, of obtaining any sounds other than the fundamentals determined by the construction of the instrument, and their related harmonics.

The ability to produce sounds of different kinds has been regarded as the prerogative of string instruments which, as well as being able to produce natural harmonics on the open strings, can produce other harmonics by pressing the string against the fingerboard at one point and lightly touching it at another.

It should further be noted that in string instruments, beginning with the harmonic at the fifth position on the lowest string, each harmonic can be obtained in different ways, according to whether it is natural or artificial, according to whether it is considered, for example,