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Subject: Regarding the Cooper Scales and the "Revised Cooper Scale"

REGARDING THE COOPER SCALES AND THE "REVISED COOPER SCALE"

I have recently had the opportunity to read and carefully examine the document entitled "Cooper's Scale Revisited" posted on the internet by Messrs Wye, Bennett, and Spell. The following history and comments are mine and do not necessarily reflect the viewpoint(s) of the current owners of my former company, Brannen Brothers Flutemakers, Inc.

HISTORY:

My collaboration with Albert Cooper began in April of 1974 when I travelled to London on behalf of my employer, Verne Q. Powell Flutes, to investigate the possibility of using Mr. Cooper's scale formulas on Powell flutes. We quickly hit it off and came to an agreement that he would license the use of his scales and the term "Cooper Scale" to the Powell Company. By August of 1974 the first examples of Powell flutes with Cooper Scales were complete and they were shown at the National Flute Association convention in Pittsburg, PA (USA). With Albert in attendance, explaining his work and how to test for accurate intonation, he and the flutes were an immediate and overwhelming success. It is safe to say that players and makers alike rushed to learn more about his work and to obtain the flutes and/or the information about his scales.

In the course of preparing to build flutes with his scales, Mr. Cooper imparted a great deal of information to me as to how he had arrived at his formulas. This took two forms: During our initial meeting he presented me with a highly detailed notebook showing his research, formulas, and the conclusions he had reached regarding flute scales. At subsequent meetings, which lasted for three days, he allowed me to record his explanations as we reviewed his research. The notebook and the recordings still exist and have been invaluable over the years. The Flute by Albert Cooper, which was published several years later by his manager, Alex Weeks, contained no specifics about scales.

Albert and I maintained a successful working relationship for more than twenty-four years. He was a founding Director and shareholder of our company, Brannen Brothers Flutemakers, and served as Director of Research until he retired in 1998. We continued to correspond until illness made it impossible for him to respond.

THE COOPER SCALE(S):

Albert Cooper was a painstakingly thorough researcher, quite remarkable given his relatively modest education. He thrived on detail, was an excellent listener, and was passionate about his work. As he began to realize that there was a need for

improvement in the flute, especially regarding intonation, he started making changes. Initially it was done empirically, with some limited success, but he soon realized that a more systematic approach was necessary. He then, with help from a number of others, embarked on a more scientific approach which ultimately led to what are now known as the Cooper Scales.

The following is an excerpt from the notebook Albert gave to me in 1974:

“It will (also) become painfully obvious that I have had no scientific or acoustical training, nevertheless I hope my neutral approach to this complex subject does offer something. I like to think that I am a good listener; by that I do not mean I have a good ear for pitch; I like to hear constructive comments from players, and the London players to me have become the most critical in the world. I believe I have helped to make them so. We may not be always in full agreement but I hope the majority are on my side. One sometimes hears an interesting opinion from the amateur player; they are by no means to be ignored; this also applies to the student. I feel it would be wrong if I were to learn the art of flute playing and inflict my idea of a flute scale on my would be customers. I can always get a good cross section of opinion just for the asking – which is more valuable to me than the opinion of one man whoever he is. To satisfy the majority is the best aim because no one can ever satisfy all.”

WHAT IS A COOPER SCALE? WHAT ARE THE COOPER SCALES?

In a nutshell, it is the logical positioning of optimally sized toneholes to create a flute scale that plays well in tune at a specified pitch over at least three octaves. Originally Albert plotted five scales from A-441 to A-445, with two variants for each pitch: covered key and open hole. After several years and much added experience, it was decided that the A-441 scale was marginally too low, and the remaining four scales (in ascending order) were re-designated A-440, A-442, A-444, and A-446.

The process of creating a scale for any given pitch begins with determining the correct “octave length”. This is done by placing equal-sized toneholes (3) on a tube so that the A nat, C nat1 and C nat2 are in tune with each other at a given pitch, i.e., A-440. To the best of my knowledge, Albert did this without the assistance of any electronic devices. It is essentially the same way Theobald Boehm did it 125 years earlier to create his schema. Why is there a difference between Cooper’s and Boehm’s numbers? One can only guess, but two factors come to mind. First, there has been considerable growth in the understanding of acoustics since Boehm’s research, and secondly, the headjoints used in Boehm’s time are much different than now. In any event, the octave lengths used by Boehm and Cooper for a given pitch are surprisingly close.

The next step is to determine the placement of the semitones within the octave length. This is a purely mathematical exercise and is the same process used to determine fret spacing on a guitar or mandolin. At this point we have a theoretically

accurate covered key scale with equal-sized toneholes, however, such a flute would be of little or no use. It is necessary to now build some compensations/compromises into the scale to make it friendlier to the player. Some examples are: *

1. The F# tonehole must be moved slightly toward the headjoint to compensate for the effect of closing the D nat key.
2. The D nat tonehole needs to be moved slightly down the flute to keep the D nat2 from being too sharp. Some may disagree with this, but keep in mind that Albert had his reasons!
3. The closed G# tonehole is moved down the flute to compensate for the enlarged bore at that point due to the duplicate mainline (offset G) G# tonehole.
4. The small C#2 tonehole: Albert agonized over this one more than any other, taking into account the multiple functions it must serve. He admitted freely that while he preferred the location he chose, others might prefer a different one.

* I am not at liberty to give specific dimensions for these examples because that information passed to the new owners of Brannen Brothers Flutemakers when I sold the company, and therefore it is not mine to divulge.

Once the compensations/compromises are made, and there are many more to be considered, the final size of the toneholes must be chosen. Albert was very specific about one area in particular – the left hand notes from G# to C nat. He felt that beyond a certain size, less than the most commonly used one, problems arise in the third octave. To him, this was a problem on most old French flutes as well as most American-made flutes. In order to change tonehole sizes while maintaining the same pitch, he utilized a relatively simple graph which designated the appropriate movement up or down the flute for any change in tonehole diameter.

The next point on which he insisted was that closed hole and open hole flutes must have different scales. The changes only apply to the location of the toneholes under the five open-holed (French) key cups, but they must be moved away from the headjoint to adjust for the extra venting.

Finally, the issue of key rise/opening was determined. Most players seem comfortable with the centerjoint keys opening 3 to 3.2 mm, roughly 1/8". Footjoint keys are open somewhat more. It's really a matter of personal preference so long as it is not so close as to muffle the sound.

CONCLUSION:

In writing this, although it is at best very condensed, it is my hope that those reading it will understand the thoroughness with which Mr. Cooper pursued his development work. The statement made by Messrs Wye, Bennett, and Spell, that "Cooper's scale is no longer fit for purpose" is grossly inaccurate. This work is as relevant and accurate today as it was nearly forty years ago.

I have no issue with those who disagree and choose to do further research into the matter of scales, and if studying Mr. Cooper's scales is part of that research, I commend them for their thoroughness.

That said, I wish to make it known that I have very serious issues with anyone who presumes that they have the right to revise Mr. Cooper's work without his permission and to publish it as "The Revised Cooper Scale".

In order for a revision of something to take place, there must be some recognizable common ground between the new and the original. I can find no meaningful similarities between the work of Messrs Wye, Bennett, and Spell and the work of Mr. Cooper, with which I am thoroughly familiar. In virtually all instances toneholes have been moved far beyond the tolerances Mr. Cooper allowed. In my opinion this does not constitute a revision of Mr. Cooper's work, but an entirely different concept of "Scale".

It is not my intention to demean or challenge the work of these gentlemen, but as a measure of respect to the man who, by their own admission, has contributed generously and selflessly to so many, they should call their work what it is - The Wye, Bennett, and Spell Scale (or whatever they choose without Mr. Cooper's name) - and let it stand on its own merits.

Respectfully,
Bickford W. Brannen
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