

Presented at the
April 1985 Convention of the
National Association of Professional Band Instrument
Repair Technicians
PRACTICAL ACOUSTICS FOR TECHNICIANS

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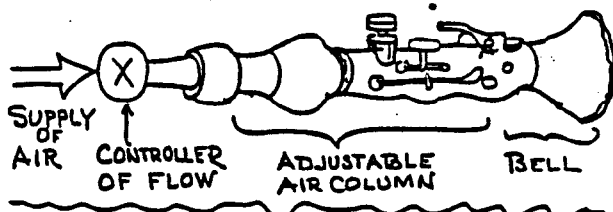
Cleveland, OH 44106

Introductory Remarks

The tuning, tone, and response of wind instruments depends a lot on microscopic effects in the air column, and it is easy to lose one virtue while going after another. Everything affects everything! Today's acoustics is far enough along that it is possible to organize and coordinate a lot of things the repairman is faced with in his daily work. For woodwinds, the "do and don'ts" of pad choice and regulation, and the coordination of mouthpiece and barrel, or of flute headjoint to the instrument can be dealt with in a very practical way, as can questions like "Should the bore be oiled?" or "How should a joint be fitted?" "What pitch was this horn actually built to?" Among the brass instruments we have similar questions: "How does one make sure the mouthpiece belongs with the horn?" "Is it worse to fix this dent than to leave it alone?" (flute man take notice!) "Can I look for (and fix?) bore errors via tuning experiments?" My goal is to get people started thinking about such questions in a way that shows how closely related they all are to each other acoustically. The discussion can go on from here in a free-wheeling way. Hopefully people will bring odd or sick instruments plus plenty of questions.

WHAT IS A WIND INSTRUMENT?

HOW ARE ITS MUSICAL OSCILLATIONS MAINTAINED?



WOODWIND DEFINED ACOUSTICALLY

SEQUENCE OF TONE-HOLES

BRASS DEFINED ACOUSTICALLY

AIR COLUMN LENGTH VARIED BY PISTONS OR SLIDE

SOUND ISSUES FROM WHATEVER HOLES ARE OPEN
SOUND ISSUES ALWAYS VIA THE BELL

EXCITATION MECHANISM (FLOW CONTROLLER)

1. Cane reed (Oboe, clarinet, sax)
 2. Lip reed (Trumpet, cornetto)
 3. Air reed (Flute)
- 1) AVAILABLE TO BOTH TRIBES!

PROPERTIES OF A GOOD INSTRUMENT

- (1) Full steady tone...
(sustable spectrum, small FM/AM noise)
- (2) Clean start and stop
(controllable articulation - dependable)
- (3) Wide dynamic range.
(stable and controllable)
- (4) Pitch flexibility without loss of tone
Tonal flexibility without loss of pitch

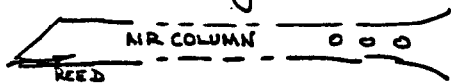
(5) Large muscular efforts control small musical changes, but with preservation of (2), (3) and (4)

IMPORTANCE
EASY BLOWING,
EASIER MUSIC
IS ESSENTIAL

Permits fine control
Protects from small glitches

It wants to do your bidding!

The "tone breeding" process



- (A) The reed sends a pressure pulse down the bore
- (B) This is magnified by the tone holes and bell and sent back
- (C) The return wave produces a new, re-modified pulse from the reed valve.
- (D) This goes down... Etc Etc.....

If all goes well, things settle down to a nice, clear, steady regime of oscillation.

"Chewed up return" ↔ "Screwed up" pulse from reed (etc etc)

It is already obvious that all this scurrying back and forth means that

BIG IDEA #1

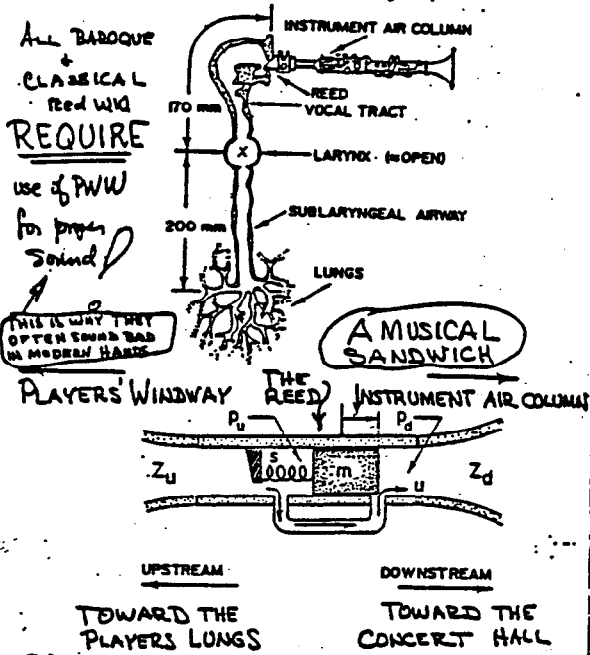
EVERY PART OF THE BORE IS CRUCIALLY IMPORTANT

There is no magic spot that fixes everything.

[even if there were, it might well be the magic spot that spoils some other note!]

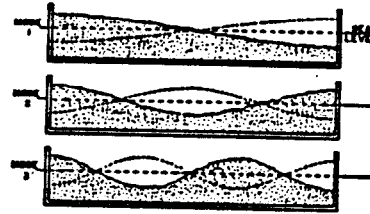
A WIND INSTRUMENT IS A SYSTEM (actually each fingering is a system but shared with most others)

IN FACT, MUSIC EXPLOITS TWO AIR COLUMNS!

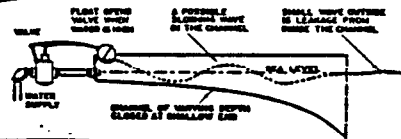


WE WILL CONSIDER ONLY THE INSTRUMENT AIR COLUMN

THERE IS A PARALLELISM BETWEEN THE MOTION OF WATER AND OF AIR



DEPTH OF WATER ← COGNATES → PRESSURE OF AIR

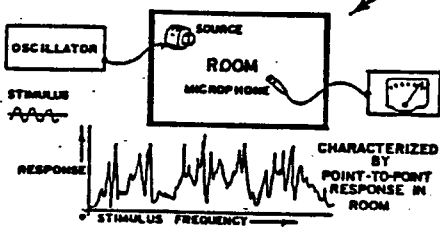


SMOOTH LIFTING AND FALLING OF THE FLOAT → PRODUCES →

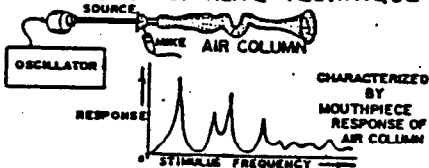
ABRUPT INJECTION OF WATER IN SHORT BURSTS

HOW TO USEFULLY CHARACTERIZE AN AIR COLUMN

REMEMBER THIS EXPERIMENT



WE EMPLOY A SIMILAR TECHNIQUE



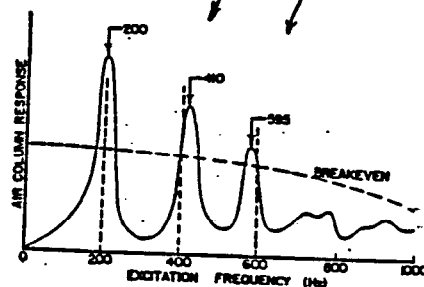
ONE CAN LEARN TO "READ OFF" THE DYNAMICAL AND MUSICAL FEATURES OF AN AIR COLUMN FROM THIS SIGNATURE

THIS CONFERS ENORMOUS DIAGNOSTIC POWER

HERE IS A RESPONSE CURVE FOR OBOE OR BASS



RESONANCES ARE NOT QUITE "ALIGNED"



ON CRESCENDO THIS INSTRUMENT WOULD DRIFT SHARP, THEN FALL A LITTLE AND TURN WOBBLY

DEMONSTRATIONS

CONCLUSION:

ALL GOOD INSTRUMENTS
(of the self-sustaining oscillator type)

1. ACQUIRE THEM (STABILITY AND CONTROLLABILITY AND ALSO THEIR ADJUSTABILITY)

AS THE RESULT OF THE POSSIBILITY OF ALIGNING MANY RESONANCES TO ASSURE QUICK RESPONSE AND NOISE FREE SOUND

- Some of this depends on the skill of the instrument maker
- Some depends on the skill of the performer

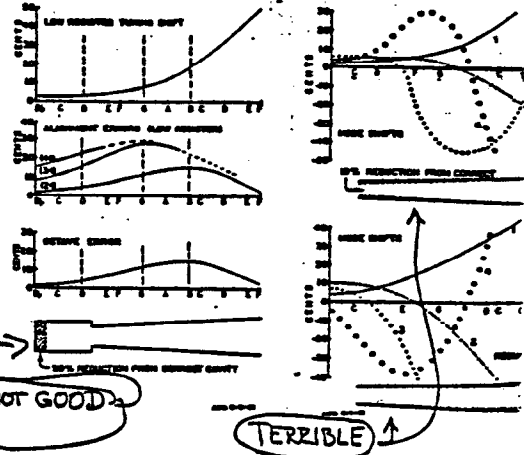
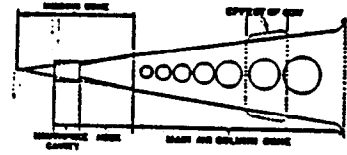
BOTH ASPECTS ARE WELL UNDERSTOOD AND CAN BE TAUGHT BY KNOWN METHODS.

2. THEY PRODUCE SOUNDS OF A TYPE THAT THE AUDITORY SYSTEM IS PECULIARLY WELL-FITTED TO RECEIVE (EXAMPLES WILL BE OFFERED AS TIME PERMITS)

SUCH SOUNDS ARE THEREFORE **PERCEPTUALLY ROBUST** (partial survival permits successful recognition)

3. THEY CAN SURVIVE THE VOYAGE TO THE EAR!

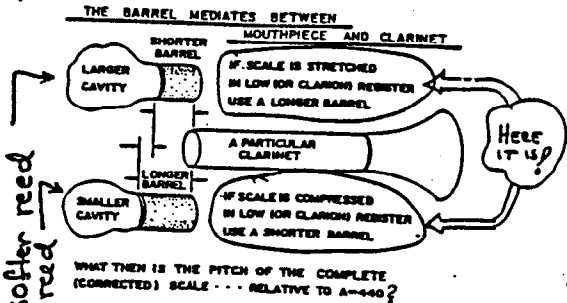
AS WE ALL KNOW SAX (OBOE, BASSOON) SENSITIVITY TO WRONG REED CAVITY NECK TAPER IS VERY GREAT



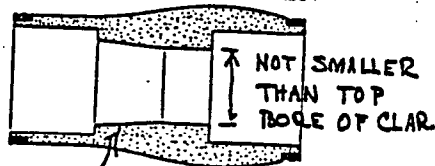
LIFE IS SIMPLER FOR CLARINETS

Without arguing (here) about Correct Chops assume good instrument, good mouthpiece, good chops

Then:



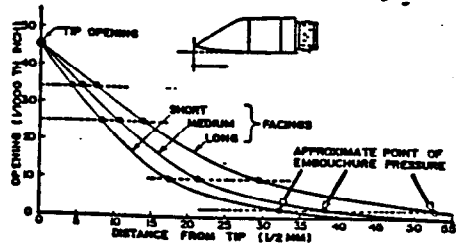
softer reed
harder reed



ESSENTIAL ENLARGEMENT? - does not have to match mouthpiece ID.

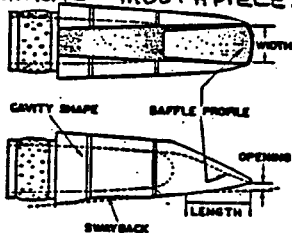
ABSOLUTE REQUIREMENTS FOR A FACING...

- (1) There must be a point where embouchure pressure changes (without sliding) will change free vibrating length of reed
Test: will the mpc alone + reed "yap" from well below "normal" to well above "normal" pitch eg a range of 8-12 semitones??

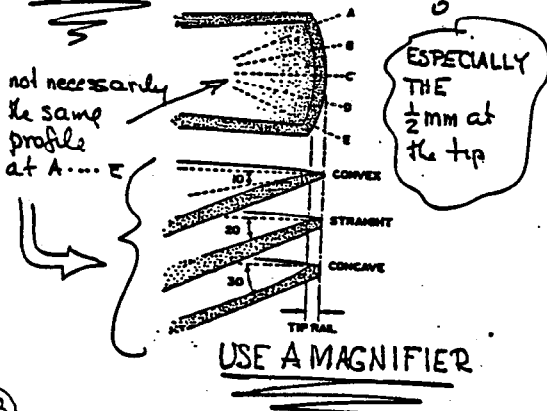


- (2) The reed must 'roll down' on the facing smoothly as it closes. under all conditions of emb tension and blowing pressure
CHECK BEST WITH #2 REED (Pretty Soft!)

IT REALLY IS POSSIBLE TO MAKE IDENTICAL MOUTHPIECES

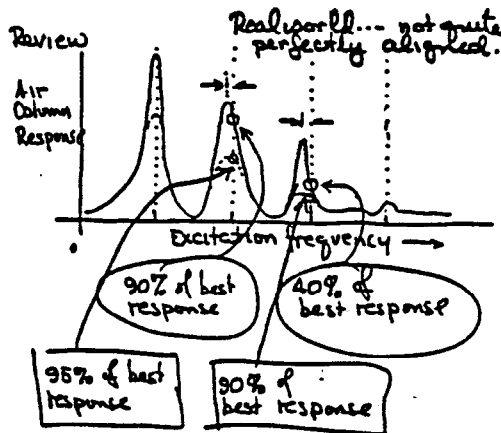


EVERYTHING MATTERS



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WHAT ABOUT AIRTIGHTNESS AND HARDNESS OF PADS?



More porosity of pads (or wood) with in reason Better cooperation

Better music at expense of a little more work from the player

(14)

POROSITY..... GOOD? BAD?

FLUTE: — AIRTIGHT AS POSSIBLE

BASSOON: — FAIR POROSITY IS USEFUL (Necessary)

OBOE: — AIRTIGHT BUT SOFT PADS ARE A GREAT BENEFIT I.E ... NOT CORK

CLARINET: — PRETTY AIRTIGHT . PLUS SOFT PADS

THE QUICKEST WAY TO RUIN WHAT LITTLE TONE TODAY'S CLARINET HAS IS TO PUT CORK PADS ON TOP JOINT

SAX: — KID PADS WITH SMALL DISCS THROUGHOUT ... THEN VARNISH THE PADS IN THE LH STACK C# --- A ONLY. MAKE THESE HARD AND IMPERVIOUS

(15)

TUNING AND VOICING

1. GET IT TO SING ALL NOTES THEN TUNE THE WHOLE INSTRUMENT

ONLY A BADLY MADE INSTRUMENT HAS BAD INDIVIDUAL NOTES

2. DONT USE THE STROBOCONN (et.) AS A TUNING GUIDE

IT KNOWS NOTHING!
(IT IS A MEASURING TOOL -- ONE) (AMONG MANY. USE IT SO.)

3. TUNE NOTE RELATIONSHIPS WITH CHOPS SET FOR BEST TONE ON EACH MEMBER OF THE SET

Quick "CRACKING OF OCTAVES" WITH FIXED CHOPS HAS RUINED MANY AN INSTRUMENT IN THE TUNER'S SHOP

It only seems to play like a

(16)

OVER THE PAST DOZEN YEARS
WE HAVE DEVELOPED

AN EXTENSIVE SET OF SYSTEMATIC
"PLAYING EXPERIMENTS"

TO UNCOVER THE STATE OF
ALIGNMENT (ETC) OF RESONANCES
AND TO GUIDE THE ADJUSTMENT PROCESS
OF WIND INSTRUMENTS

FLUTE, CLARINET, BASSOON, SAX, OBOE
AND TO A CONSIDERABLE EXTENT
THE BRASSES

These can be taught, along with their
effective use in the real world -

They are not easily written up
(some anyhow) Ask GEORGE!

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ON A CUSTOMER'S HORN
WHATEVER IT IS, **DONT DO IT**

UNLESS YOU CAN SAY **BEFOREHAND**

1. EXACTLY WHAT EFFECT IT WILL
HAVE ON ALL PLAYING BEHAVIOR
2. EXACTLY WHAT EVIDENCE YOU
HAVE FOR DOING IT
3. EXACTLY WHEN THIS CHANGE
SHOULD NOT BE MADE
4. EXACTLY HOW TO RECOGNISE
WHEN THE "DOSAGE" IS ENOUGH

LEARN THE ANSWERS TO THESE QUESTIONS
ON YOUR OWN GUINEA PIG HORNS

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