

Aaron Dan

**49,43 nm**

*Testosteron*

für Bläserquintett

04. 2013

Die Komposition „49,43 nm“ ist ein Auftragswerk des Museums für Naturkunde Berlin als Beitrag zur Sonderausstellung „Entwicklungen - 60 Jahre Entdeckung der DNA-Struktur“.

Als Grundgerüst gilt die Basenanordnung des Hormons Testosteron, welches aus insg. 1454 Basenpaaren besteht und damit die Länge der Komposition (1454 16-tel in 92 Takten) vorgibt.

Die für die Klänge verwendeten Töne wurden mit Hilfe eines Vakuum-Spektrophotometers bestimmt. Da die Basen Adenin, Thymin, Guanin und Cytosin alle aus Kohlenstoff, Wasserstoff, Sauerstoff und Stickstoff in verschiedenen Zusammenstellungen bestehen, reagieren sie auf die Bestrahlung mit Infrarotstrahlung unterschiedlich: sie absorbieren unterschiedliche Lichtspektren. Das Spektrum jeder dieser Basen weist 15-23 Absorptionsmaxima auf, sog. Eigenfrequenzen, welche eine Art Fingerabdruck des Moleküls darstellen. Sie können direkt in Wellenlängen oder - im Bereich der Spektrophotometrie noch üblicher - deren Kehrwerte, die Wellenzahlen übersetzt werden. Eine Wellenzahl gibt dabei die Anzahl der Schwingungen einer Eigenfrequenz pro cm wieder.

Die Wellenzahl einer solchen Eigenfrequenz verwandle ich nach folgender Vorschrift in einen hörbaren Ton:  
Tonfrequenz TF (Hz) =  $(1/2)^{36} * \text{Lichtgeschwindigkeit} * \text{Wellenzahl}$

Hierbei dient die 36-fache Halbierung (also 36-fache Oktavierung nach unten) dazu, den Ton in den Wahrnehmungsbereich des menschlichen Gehörs zu verschieben.

Beispiel: Wenn die Wellenzahl eines Absorptionsmaximums 2900 1/cm beträgt, ergibt mit der Lichtgeschwindigkeit von 29979245800 cm/s die Tonfrequenz

$$\begin{aligned} \text{TF} &= (1/2)^{36} * 29979245800 \text{ cm/s} * 2900 \text{ 1/cm} \\ &= (1/2)^{36} * 8,693981282 * (10^{12}) \text{ 1/s} \\ &= 1265,14078612672 \text{ Hz} \end{aligned}$$

Dieser hörbare Ton liegt nur knapp über dem Ton D#3 und wird daher auf diesen abgebildet.

Da jede der DNA-Basen einen Fingerabdruck von 15 bis 23 Eigenfrequenzen aufweist, wurde in diesem ersten Schritt ein ebenso großer Tonvorrat gewonnen.

In einem zweiten Schritt habe ich diesen Fingerabdruck auf 4 bis 5 Töne komprimiert. Aus ihnen konnte nun je ein charakteristischer Akkord pro Base gebildet werden.

Zusätzlich zu diesen Akkorden, die sozusagen die Sprossen der Doppelhelix-Leiter bilden, sollen unterschiedliche, immer paarweise auftretende Klänge aus Luft- und Klappengeräuschen die Zuckerphosphatstränge darstellen.

Der Titel „49,43 nm“ deutet auf die Länge des 1454 Sprossen zählenden DNA-Abschnitts, der Testosteron kodiert. Während in jedem menschlichen Zellkern über 2 Meter an DNA enthalten sind, ist dieser Teil nur 49,43 Nanometer lang.

Aaron Dan, im April 2013

# 49,43 nm

DNA 8 (Testosteron)

Aaron Dan, 4.4.2013

$\text{♩} = 80$

*p*

*p*

*p*

*Luft*

*f*

*p*

**4**

*Luft*

*Luft*

*f*

*Luft*

*Luft*

**7**

*Luft*

*Luft*

*Luft*

*p*

*poco*

*poco*

*Luft*

3 **9**

*ffz* *p* *sfpp* *p*

**11**

*ffz* *p* *p*

**13**

*p* *p*

*niente*

16

Musical score for measures 16-18. The score consists of five staves. The first three staves are grouped together. The first staff has a dynamic marking of *ff* and a hairpin leading to *niente*. The second and third staves have a dynamic marking of *sffzpp*. The fourth staff has a dynamic marking of *sffzpp*. The fifth staff has a dynamic marking of *ff* and a hairpin leading to *niente*. The score includes various rhythmic patterns, including eighth and sixteenth notes, and rests.

19

Musical score for measures 19-20. The score consists of five staves. The first staff has dynamic markings of *p*, *fff*, and *p*. The second staff has dynamic markings of *p*, *fff*, and *p*. The third staff has dynamic markings of *p*, *fff*, and *p*. The fourth staff has dynamic markings of *p*, *f*, and *p*. The fifth staff has dynamic markings of *p* and *f*. The score includes various rhythmic patterns, including eighth and sixteenth notes, and rests.

21

Musical score for measures 21-23. The score consists of five staves. The first staff has dynamic markings of *f* and *p*. The second staff has dynamic markings of *f* and *p*. The third staff has dynamic markings of *f* and *p*. The fourth staff has dynamic markings of *f*, *p*, and *ff*. The fifth staff has dynamic markings of *p* and *p*. The score includes various rhythmic patterns, including eighth and sixteenth notes, and rests.

23

Musical score for measures 23-24. The score consists of five staves. The first two staves are in treble clef, and the last three are in bass clef. Measure 23 features a complex texture with a dense, multi-measure rest in the upper staves and active lines in the lower staves. Measure 24 continues this texture with various rhythmic patterns and articulations.

25

Musical score for measures 25-26. The score consists of five staves. Measure 25 shows a continuation of the complex texture from the previous measures, with a multi-measure rest in the upper staves. Measure 26 features a more active texture with various rhythmic patterns and articulations, including accents and slurs.

27

Musical score for measures 27-28. The score consists of five staves. Measure 27 features a complex texture with a multi-measure rest in the upper staves and active lines in the lower staves. Measure 28 continues this texture with various rhythmic patterns and articulations, including accents and slurs.

poco più mosso

6

30

Musical score for measures 30-34. The score consists of five staves. The first and fourth staves begin with a dynamic marking of *sfz* (sforzando) and *sfz* (sforzando), which then changes to *f* (forte) and *f* (forte) respectively. The second, third, and fifth staves begin with a dynamic marking of *f* (forte) and *f* (forte) respectively. The tempo marking *poco più mosso* is indicated at the top. The music features a mix of eighth and sixteenth notes, with some measures containing rests. The dynamics transition from *f* (forte) to *p* (piano) towards the end of the section.

35

Musical score for measures 35-36. The score consists of five staves. The music is characterized by a dense texture of sixteenth notes and eighth notes, with some measures containing rests. The dynamics are primarily *f* (forte) and *p* (piano).

37

Musical score for measures 37-40. The score consists of five staves. The music is characterized by a dense texture of sixteenth notes and eighth notes, with some measures containing rests. The dynamics are primarily *f* (forte) and *p* (piano).

7  
39

Musical score for measures 39-40. The score consists of five staves. The top staff has a complex melodic line with many slurs and accents. The second and third staves are mostly rests. The fourth and fifth staves have a simple accompaniment with a *sfz* dynamic marking. The key signature has one sharp (F#).

41

Musical score for measures 41-42. The score consists of five staves. The top staff has a melodic line with slurs and accents, including a *legato 6* marking. The second staff has a simple accompaniment with a *fp* dynamic marking. The third and fourth staves have a complex melodic line with many slurs and accents. The fifth staff has a simple accompaniment. The key signature has one sharp (F#).

43

Musical score for measures 43-44. The score consists of five staves. The top staff has a melodic line with slurs and accents, including a *pp sub.* marking and a *staccato* marking. The second staff has a simple accompaniment with a *pp sub.* marking. The third and fourth staves have a complex melodic line with many slurs and accents. The fifth staff has a simple accompaniment. The key signature has one sharp (F#).



45

*sfz*

*sfz*

*sfz*

*sfz*

*sfz*

46

*sfp*

*sfp*

*sfp*

*sfp*

*sfp*

48

*sfz*

*sfz*

*sfz*

*sfz*

*sfz*

9 **51**

Musical score for measures 51-53. The score consists of five staves. The first four staves are treble clefs, and the fifth is a bass clef. The music features complex rhythmic patterns with many sixteenth and thirty-second notes. Dynamic markings include *fff*, *f*, *mf*, and *p*. There are also hairpins indicating crescendos and decrescendos. The key signature has one sharp (F#).

**54**

Musical score for measures 54-57. The score consists of five staves. The first four staves are treble clefs, and the fifth is a bass clef. The music continues with complex rhythmic patterns. Dynamic markings include *sfz* and *p*. There are also hairpins indicating crescendos and decrescendos. The key signature has one sharp (F#).

**58**

Musical score for measures 58-61. The score consists of five staves. The first four staves are treble clefs, and the fifth is a bass clef. The music continues with complex rhythmic patterns. Dynamic markings include *sfz* and *sfp*. There are also hairpins indicating crescendos and decrescendos. The key signature has one sharp (F#).