

Andrián Pertout

The Elements

for Violin

No. 403

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Composed in May, 2009

Commissioned by American Violinist Piotr Szewczyk

Hommage à Olivier Messiaen (1908-1992)

Winner in the 'Advanced Level' Category of the International Music Prizes
for Excellence in Composition 2009 (Thessaloniki, Greece)

Duration: 4'48"

PROGRAMME NOTES

In his mathematical and geometric treatise *Elements* of circa 300 BC, Greek mathematician Euclid first defined primality (the property of being a prime number, and hence numbers divisible only by themselves and one). According to the preface contained in a new one-volume edition of T.L. Heath's translation of the thirteen books of Euclid's *Elements* published by Green Lion Press, "Euclid's *Elements* has stood for well over two millenia as the exemplar, not just of classical geometry, but of the axiomatic and deductive structure characteristic of all pure mathematics. Its range goes beyond what we think of as geometry, extending to the general theory of proportions, number theory, and an innovative and ingenious treatment of incommensurability." The treatise also explores the close relationship between perfect numbers and Mersenne primes, and the theorem that "if M is a Mersenne prime then $M(M+1)/2$ is a perfect number." Perfect numbers are "numbers that are equal to the sum of their proper divisors, or $2^{n-1}(2^n - 1)$," such as the even perfect numbers 6 and 28, because $6 = 1 + 2 + 3$ and $28 = 1 + 2 + 4 + 7 + 14$; while a Mersenne prime (in reference to 17th century French monk and mathematician Marin Mersenne [1588-1648] and his 1644 treatise *Cogitata Physica-Mathematica*) is a "prime number that is one less than a power of two, or $M_n = 2^n - 1$." To date, no odd perfect numbers have ever been discovered, and there is knowledge of only forty-six Mersenne primes, which are suspected of being of an infinite number.

The First 500 Prime Numbers

2 3 5 7 11 13 17 19 23 29 31 37 41 43 47 53 59 61 67 71
73 79 83 89 97 101 103 107 109 113 127 131 137 139 149 151 157 163 167 173
179 181 191 193 197 199 211 223 227 229 233 239 241 251 257 263 269 271 277 281
283 293 307 311 313 317 331 337 347 349 353 359 367 373 379 383 389 397 401 409
419 421 431 433 439 443 449 457 461 463 467 479 487 491 499 503 509 521 523 541
547 557 563 569 571 577 587 593 599 601 607 613 617 619 631 641 643 647 653 659
661 673 677 683 691 701 709 719 727 733 739 743 751 757 761 769 773 787 797 809
811 821 823 827 829 839 853 857 859 863 877 881 883 887 907 911 919 929 937 941
947 953 967 971 977 983 991 997 1009 1013 1019 1021 1031 1033 1039 1049 1051 1061 1063 1069
1087 1091 1093 1097 1103 1109 1117 1123 1129 1151 1153 1163 1171 1181 1187 1193 1201 1213 1217 1223
1229 1231 1237 1249 1259 1277 1279 1283 1289 1291 1297 1301 1303 1307 1319 1321 1327 1361 1367 1373
1381 1399 1409 1423 1427 1429 1433 1439 1447 1451 1453 1459 1471 1481 1483 1487 1489 1493 1499 1511
1523 1531 1543 1549 1553 1559 1567 1571 1579 1583 1597 1601 1607 1609 1613 1619 1621 1627 1637 1657
1663 1667 1669 1693 1697 1699 1709 1721 1723 1733 1741 1747 1753 1759 1777 1783 1787 1789 1801 1811
1823 1831 1847 1861 1867 1871 1873 1877 1879 1889 1901 1907 1913 1931 1933 1949 1951 1973 1979 1987
1993 1997 1999 2003 2011 2017 2027 2029 2039 2053 2063 2069 2081 2083 2087 2089 2099 2111 2113 2129
2131 2137 2141 2143 2153 2161 2179 2203 2207 2213 2221 2237 2239 2243 2251 2267 2269 2273 2281 2287
2293 2297 2309 2311 2333 2339 2341 2347 2351 2357 2371 2377 2381 2383 2389 2393 2399 2411 2417 2423
2437 2441 2447 2459 2467 2473 2477 2503 2521 2531 2539 2543 2549 2551 2557 2579 2591 2593 2609 2617
2621 2633 2647 2657 2659 2663 2671 2677 2683 2687 2689 2693 2699 2707 2711 2713 2719 2729 2731 2741
2749 2753 2767 2777 2789 2791 2797 2801 2803 2819 2833 2837 2843 2851 2857 2861 2879 2887 2897 2903
2909 2917 2927 2939 2953 2957 2963 2969 2971 2999 3001 3011 3019 3023 3037 3041 3049 3061 3067 3079
3083 3089 3109 3119 3121 3137 3163 3167 3169 3181 3187 3191 3203 3209 3217 3221 3229 3251 3253 3257
3259 3271 3299 3301 3307 3313 3319 3323 3329 3331 3343 3347 3359 3361 3371 3373 3389 3391 3407 3413
3433 3449 3457 3461 3463 3467 3469 3491 3499 3511 3517 3527 3529 3533 3539 3541 3547 3557 3559 3571

The First 12 Perfect Numbers

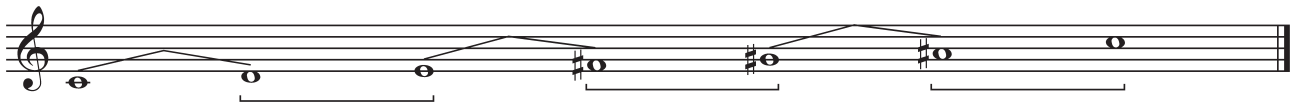
$2^1(2^2 - 1)$	6
$2^2(2^3 - 1)$	28
$2^4(2^5 - 1)$	496
$2^6(2^7 - 1)$	8128
$2^{12}(2^{13} - 1)$	33550336
$2^{16}(2^{17} - 1)$	8589869056
$2^{18}(2^{19} - 1)$	137438691328
$2^{30}(2^{31} - 1)$	2305843008139952128
$2^{60}(2^{61} - 1)$	2658455991569831744654692615953842176
$2^{88}(2^{89} - 1)$	191561942608236107294793378084303638130997321548169216
$2^{106}(2^{107} - 1)$	13164036458569648337239753460458722910223472318386943117783728128
$2^{126}(2^{127} - 1)$	14474011154664524427946373126085988481573677491474835889066354349131199152128

According to Prime Count, “the search for Mersenne primes was revolutionized by the introduction of the electronic digital computer. The first successful identification of a Mersenne prime, M^{521} , by this means was achieved at 10:00 P.M. on January 30, 1952 using the U.S. National Bureau of Standards Western Automatic Computer (SWAC) at the Institute for Numerical Analysis at the University of California, Los Angeles, under the direction of Lehmer, with a computer search program written and run by Prof. R.M. Robinson. It was the first Mersenne prime to be identified in thirty-eight years; the next one, M^{607} , was found by the computer a little less than two hours later. Three more – M^{1279} , M^{2203} , M^{2281} – were found by the same program in the next several months. M^{4253} is the first Mersenne prime that is titanic, M^{44497} is the first gigantic, and $M^{6,972,593}$ was the first megaprime to be discovered, being a prime with at least 1,000,000 digits. All three were the first known prime of any kind of that size.” The Great Internet Mersenne Prime Search (GIMPS) was formed in January 1996 by George Woltman to “discover new world-record-size Mersenne primes,” and “on August 23rd (2008), a UCLA computer in the GIMPS PrimeNet network discovered the 45th known Mersenne prime, $M^{43,112,609} - 1$, a mammoth 12,978,189 digit number.”

‘The Elements’ was commissioned by American violinist Piotr Szewczyk and is a dedication to the late French composer Olivier Messiaen (1908-1992). The title is in reference to Euclid’s mathematical and geometric treatise *Elements* of circa 300 BC, and the work serves as an exploration of Messiaen’s ‘Modes of Limited Transposition’ and ‘Nonretrogradable Rhythms’ within the structural framework of the first 36 prime numbers (2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, and 151). Every possible mode is subsequently generated from each of the seven ‘Modes of Limited Transposition’, producing a collection of twenty-two scales, which are combined to produce one-, two-, three-, and four-octave scales. ‘Nonretrogradable Rhythms’ are then constructed within the scope of each prime, with each numerical value of a prime allocated a duration of a semiquaver note. The structure of ‘The Elements’ essentially features seven distinct sections individually dedicated to one of the ‘Modes of Limited Transposition’ and five unique ‘Nonretrogradable Rhythms’; an ornamental rhythmic passage following the termination of each section acting as a type of coda. The ratio of 2:1:2 (equal to ♪+♪+♪ in the prime number 5) is utilized throughout the rhythmic scheme to delineate a contrasting central region equal to one-fifth of each of the thirty-four quintal palindromes (the primes 2 and 3 unable to yield a palindrome in the context of this scheme).

Olivier Messiaen's Modes of Limited Transposition

Mode 1 (Whole-Tone Scale)



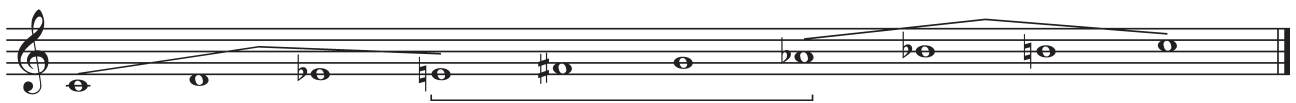
Mode 2 (Octatonic Minor or Diminished 'Half Step-Whole Step' Scale)



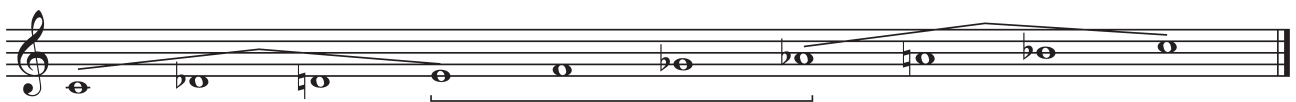
1st Mode Generated from Mode 2 (Octatonic Major or Diminished 'Whole Step-Half Step' Scale)



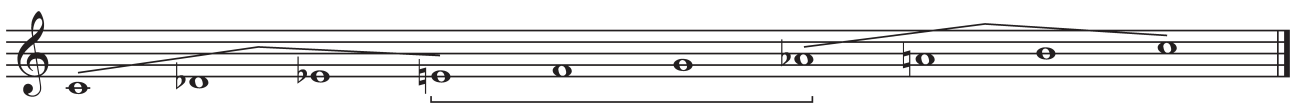
Mode 3



1st Mode Generated from Mode 3



2nd Mode Generated from Mode 3



Mode 4



1st Mode Generated from Mode 4



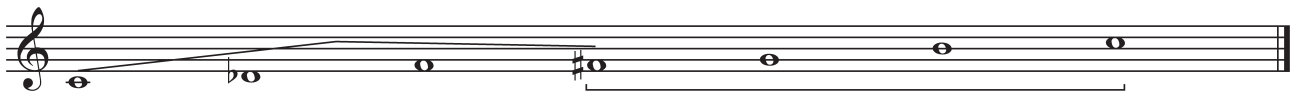
2nd Mode Generated from Mode 4



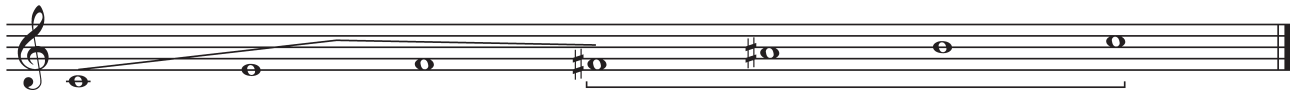
3rd Mode Generated from Mode 4



Mode 5



1st Mode Generated from Mode 5



2nd Mode Generated from Mode 5



Mode 6



1st Mode Generated from Mode 6



2nd Mode Generated from Mode 6



3rd Mode Generated from Mode 6



Mode 7



1st Mode Generated from Mode 7



2nd Mode Generated from Mode 7



3rd Mode Generated from Mode 7



4th Mode Generated from Mode 7



INSTRUMENTATION

Violin

PERFORMANCE NOTES

In this score, accidentals affect only those notes which they immediately precede; accidentals are not repeated on tied notes; and accidentals are not repeated for repeated notes unless one or more different pitches intervene. If a sharp or flat is followed directly by its natural form, a natural is used. Cautionary accidentals or naturals have been used to clarify ambiguities.



portamento (a smooth and rapid 'sliding' between two pitches, executed continuously)



glissando (a smooth and rapid 'sliding' over the keys or strings (so that every individual note is articulated, no matter how rapid the 'sliding'))



behind the bridge (play between the bridge and the tailpiece)



slap strings with palm



left-hand pizzicato



snap pizzicato (Bartók pizzicato)

Hommage à Olivier Messiaen (1908-1992)

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Andrián Pertout, No. 403

2009

Violin

$\text{♩} = 132$

8^{va}-----1

pizz. *sfz sfz* *arco* *8^{va}* *mf* *f*

4

mf *f*

7

sfz *mf*

10

arco *8^{va}* *f* *off-the-string* *sim.* *pizz.* 3

14

17

sfz *mf*

20

23

al tallone -----> *sul pont.* 5 3 *f*

26

(ord.) *off-the-string* I II I II *I II I II* *sim.* *pizz.* 3 5

arco
8va-----

29 *sfz mf*

32

35

38

41

44 *f*

al tallone
8va-----

--- sul pont. *v* spiccato (ord.)

46 *off-the-string* I III III II I II I II I *sim.* *pizz.*

49 arco
8va-----

52 *sfz mf*

55



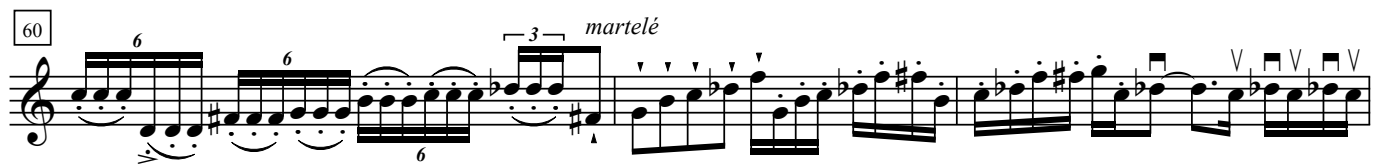
58

punta d'arco *saltando*



60

martelé



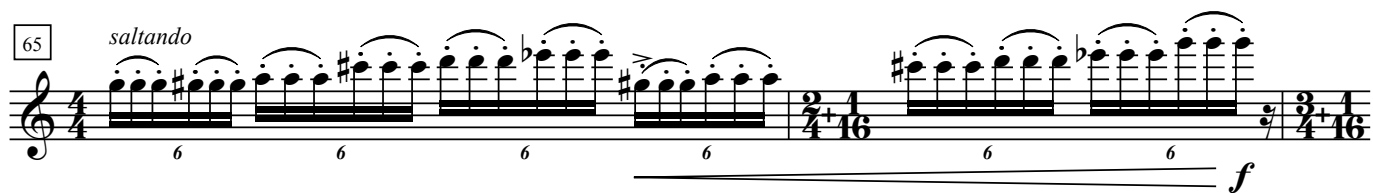
63

punta d'arco



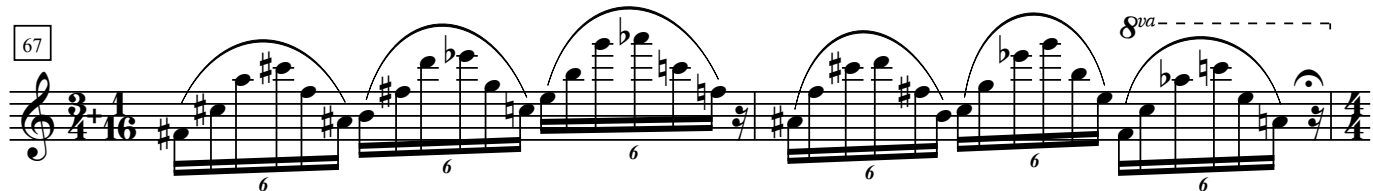
65

saltando



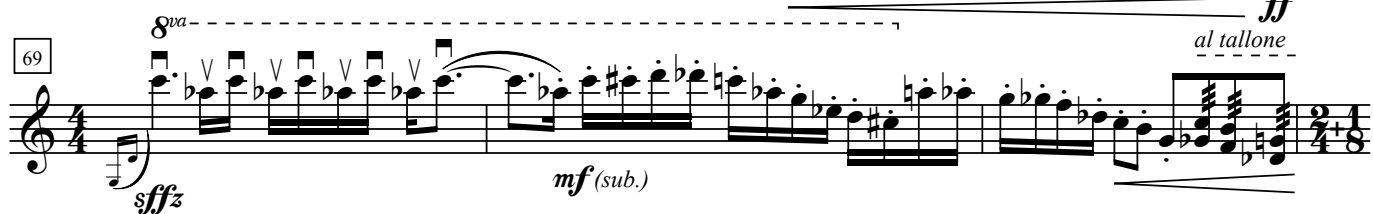
67

8va



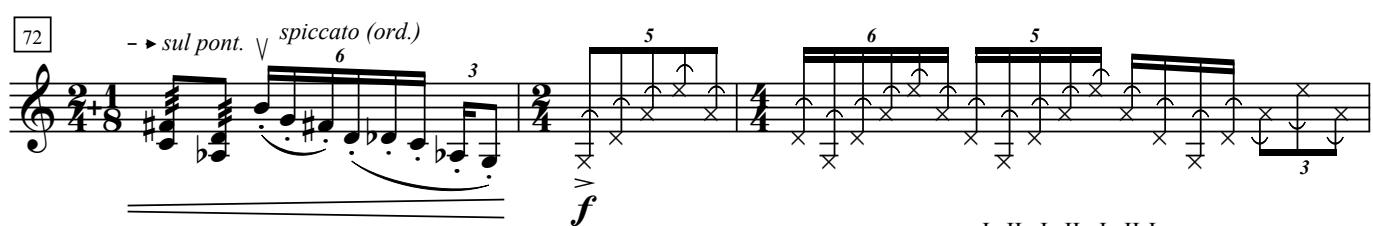
69

8va *sffz* *mf(sub.)* *al tallone*



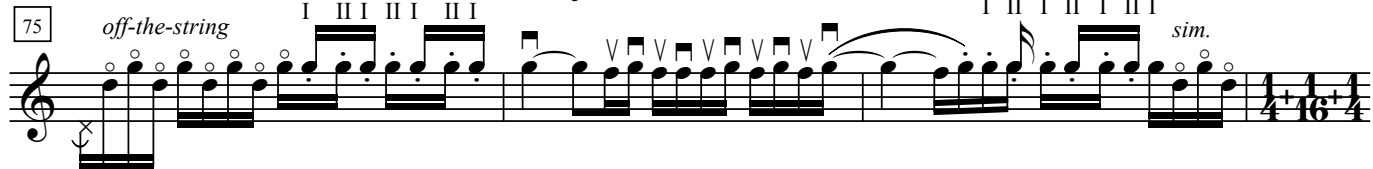
72

→ sul pont. spiccato (ord.)

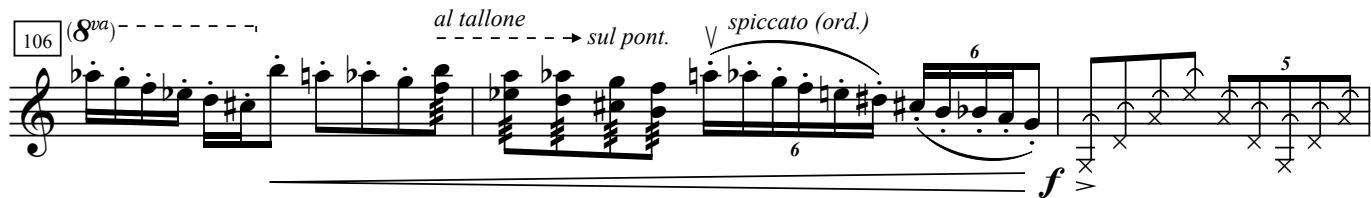


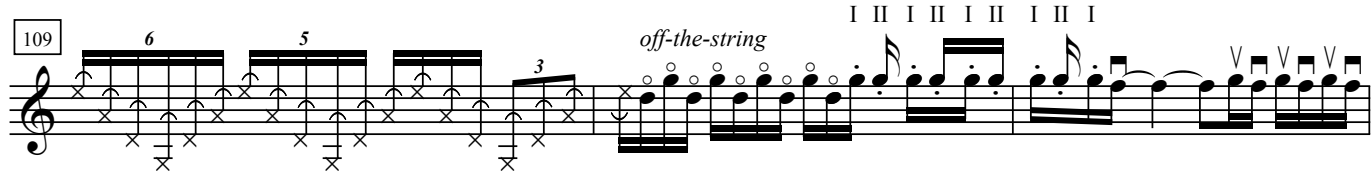
75

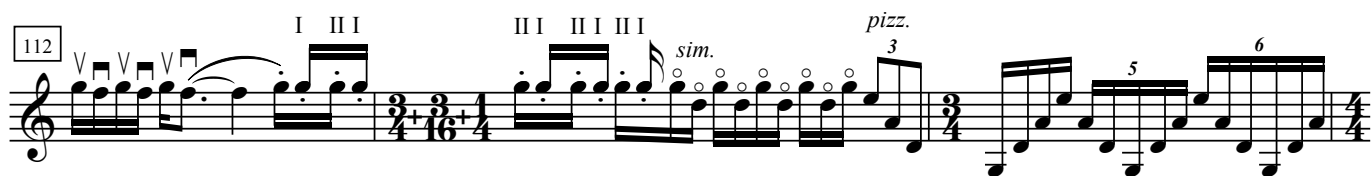
off-the-string *I III III III* *sim.*



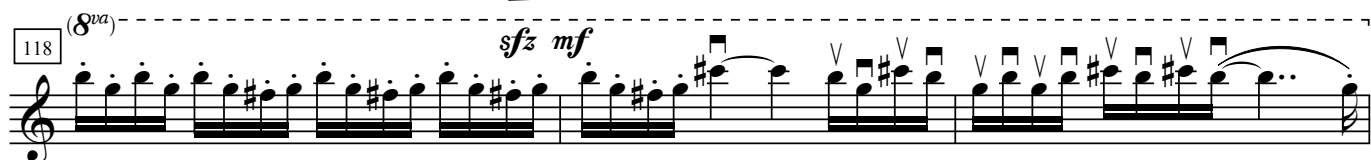
78 *pizz.* 3 5 6 5 2nd *arco (con sordino)* *8va* -----
 82 *8va* -----
 85
 88
 91 *1st* ----- *col legno battuto (ord.)*
 94 *1st* ----- *sul pont.* *arco (sul tasto)* ----- *ord.*
 97 ----- *1st* ----- *sul tasto*
 100 *col legno battuto (ord.)* ----- *1st* ----- *sul pont.* *arco (sul tasto)* ----- *ord.* *mf*
 103 *8va* -----

106 *8^{va}* *al tallone* → *sul pont.* *spiccato (ord.)*


109 *off-the-string* I III I III I III I


112 I III III III III *sim.* *pizz.*


115 *arco (senza sordino)* *8^{va}*


118 *sfz* *mf*


121 

123 

126 

129 *punta d'arco saltando* 6


132 *martelé*

134

137 *punta d'arco*

140 *saltando*

142 *f*

144 *ff*

146 *8va*, *mf (sub.)*, *ffz*

149 *8va*, *al tallone*, *sul pont.*, *spiccato (ord.)*

152 *f*

155 *off-the-string*

I III III II I II I

158

I II I II I II I II I

sim.

pizz.

3

160

5 6 5

3

pp

