

JOHN GRESCHAK

THE TOWER OF HANOI

for string orchestra

UNFINISHED

Note from the Composer

The Tower of Hanoi is a puzzle that consists of three pegs and a number of disks. Each disk has a different diameter. Initially, the disks are stacked on a single peg. Larger disks are placed under smaller disks. The object of the game is to move all disks from one peg to another. Only one disk may be moved at a time, and a disk may only be placed on top of another disk if the disk that is being moved has a smaller diameter. The puzzle was published by the French mathematician Edouard Lucas in 1883.

The following passage from *Mathematical Recreations and Essays* by W. W. Rouse Ball and H. S. M. Coxeter describes a legend that is associated with this puzzle:

De Parville gave an account of the origin of the toy which is a sufficiently pretty idea to deserve repetition. In the great temple at Benares, says he, beneath the dome which marks the centre of the world, rests a brass plate in which are fixed three diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed sixty-four discs of pure gold, the largest disc resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the Tower of Bramah. Day and night unceasingly the priests transfer the discs from one diamond needle to another according to the fixed and immutable laws of Bramah, which require that the priest on duty must not move more than one disc at a time and that he must place this disc on a needle so that there is no smaller disc below it. When the sixty-four discs shall have been thus transferred from the needle on which at the creation God placed them to one of the other needles, tower, temple, and Brahmins alike will crumble into dust, and with a thunderclap the world will vanish.

This piece was created by using musical material derived from the mathematical properties of The Tower of Hanoi and its legend. It is based upon the case that consists of five disks.

For additional information, visit <http://www.greschak.com> on the World Wide Web.

I hereby place this work that I have authored into the public domain and in the process abandon all copyright protection.

John Greschak
2001

Notation

All glissandos should be smooth slides that progress gradually from one pitch to another without articulating intermediate pitches. They should begin immediately after the initial pitch is sounded.

Accidentals affect only those notes which they immediately precede, with the exception of tied notes. Accidentals are never repeated on tied notes.

Articulation Symbols

- > Normal Accent (louder than prevailing dynamic)
- ^ v Strong Accent (louder than normal accent)
- Staccato (shorter than normal)

Duration

4 minutes

THE TOWER OF HANOI

John Greschak

♩ = 110

Violin I

pizz. *mp*

Violin II

pizz. *mp*

Viola

pizz. *mp*

Cello

mp

Contrabass

mp

3

più mosso

arco

arco

arco

p

pp

2 *a tempo*

8

Musical score for measures 8-13. The score is written for five staves. The first staff (treble clef) contains a melodic line with a key signature of one sharp (F#) and a tempo marking of *a tempo*. The second staff (treble clef) contains a melodic line with a key signature of one sharp (F#). The third staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The fourth staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The fifth staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The time signature changes from 4/4 to 3/4 to 4/4 to 3/4 to 4/4. The measure numbers 8, 9, 10, 11, 12, and 13 are indicated at the top of the staves.

14

Musical score for measures 14-18. The score is written for five staves. The first staff (treble clef) contains a melodic line with a key signature of one sharp (F#). The second staff (treble clef) contains a melodic line with a key signature of one sharp (F#). The third staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The fourth staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The fifth staff (bass clef) contains a melodic line with a key signature of one sharp (F#). The time signature changes from 4/4 to 3/4 to 6/8 to 3/4 to 6/8. The measure numbers 14, 15, 16, 17, and 18 are indicated at the top of the staves. A *mp* (mezzo-piano) marking is present below the fifth staff in measure 14.

19

Measures 19-23 of a musical score. The score is written for five staves. The first staff (treble clef) has rests in measures 19-21 and begins a melodic line in measure 22. The second staff (treble clef) has rests in measures 19-23. The third staff (bass clef) has rests in measures 19-23. The fourth staff (bass clef) has rests in measures 19-21 and begins a melodic line in measure 22. The fifth staff (bass clef) has rests in measures 19-23. The key signature has one flat (B-flat). The time signature is 4/4. The melodic lines in measures 22-23 feature eighth and sixteenth notes with accents.

24

Measures 24-28 of a musical score. The score is written for five staves. The first staff (treble clef) has a melodic line in measure 24 and rests in measures 25-28. The second staff (treble clef) has rests in measures 24-28. The third staff (bass clef) has rests in measures 24-25 and begins a melodic line in measure 26. The fourth staff (bass clef) has a melodic line in measure 24 and rests in measures 25-28. The fifth staff (bass clef) has rests in measures 24-28. The key signature has one flat (B-flat). The time signature is 4/4. The melodic lines in measures 24-28 feature eighth and sixteenth notes with accents. Dynamic markings include *mf* (mezzo-forte) in measure 26 and *pp* (pianissimo) in measure 27.

29

Measures 29-33 of a musical score. The score is written for five staves. The first staff is in treble clef, the second in treble clef, the third in bass clef, the fourth in bass clef, and the fifth in bass clef. The key signature has one flat (B-flat). The time signature is 4/4. The music features various melodic lines with accents and slurs. A dynamic marking of *mp* (mezzo-piano) is present in measure 32.

34

Measures 34-38 of a musical score. The score is written for five staves. The first staff is in treble clef, the second in treble clef, the third in bass clef, the fourth in bass clef, and the fifth in bass clef. The key signature has one flat (B-flat). The time signature is 4/4. The music continues with various melodic lines and accents. A dynamic marking of *mp* (mezzo-piano) is present in measure 34.

*meno mosso**a tempo*

39

div.

44

div.

unis.

div.

unis.

49

Musical score for measures 49-54. The score is written for five staves. The first staff (treble clef) contains the melody, which includes a key signature change from one flat to two flats at measure 53. The second staff (treble clef) provides harmonic support with chords and some melodic fragments. The third staff (alto clef) contains a continuous melodic line. The fourth staff (bass clef) provides a bass line with various rhythmic patterns. The fifth staff (bass clef) contains a simple bass line. The music is in 4/4 time and features a variety of note values, including eighth and sixteenth notes, as well as rests.

55

Musical score for measures 55-60. The score is written for five staves. The first staff (treble clef) contains the melody, which includes a key signature change from two flats to one flat at measure 59. The second staff (treble clef) provides harmonic support with chords and some melodic fragments. The third staff (alto clef) contains a continuous melodic line. The fourth staff (bass clef) provides a bass line with various rhythmic patterns. The fifth staff (bass clef) contains a simple bass line. The music is in 4/4 time and features a variety of note values, including eighth and sixteenth notes, as well as rests.

60

This system contains measures 60 through 65. It features five staves: two treble clefs at the top and three bass clefs below. The music is written in a key with one flat (B-flat) and a 3/8 time signature. Measure 60 begins with a treble staff containing a half note G4 with a fermata, followed by a quarter rest. The bass staffs contain various rhythmic patterns, including eighth and quarter notes. Measures 61-65 show a progression of chords and melodic lines across the staves, with some notes marked with accents or slurs. The system concludes with a double bar line.

66

This system contains measures 66 through 71. It features five staves: two treble clefs at the top and three bass clefs below. The music is written in a key with one flat (B-flat) and a 3/8 time signature. Measure 66 begins with a treble staff containing a half note G4 with a fermata, followed by a quarter rest. The bass staffs contain various rhythmic patterns, including eighth and quarter notes. Measures 67-71 show a progression of chords and melodic lines across the staves, with some notes marked with accents or slurs. The system concludes with a double bar line.

72

This system contains measures 72 through 76. It features five staves: two treble clefs, two bass clefs, and a fifth staff with a treble clef. The music is in a key with one flat (B-flat). Measure 72 shows a melodic line in the first treble staff with an accent, followed by a descending line in the second treble staff. The bass staves provide harmonic support with various rhythmic patterns. Measure 73 continues the melodic development. Measure 74 features a more active bass line in the fourth staff. Measure 75 shows a continuation of the melodic and harmonic themes. Measure 76 concludes the system with a final chordal structure.

77

This system contains measures 77 through 81. It features five staves: two treble clefs, two bass clefs, and a fifth staff with a treble clef. The music continues in the same key. Measure 77 begins with a melodic phrase in the first treble staff. Measure 78 shows a continuation of the melodic line. Measure 79 features a more active bass line in the fourth staff. Measure 80 shows a continuation of the melodic and harmonic themes. Measure 81 concludes the system with a final chordal structure.

82

Musical score for measures 82-86. The score is written for five staves. The first staff is in treble clef, the second in treble clef, the third in bass clef, the fourth in bass clef, and the fifth in bass clef. The key signature has one sharp (F#). The time signature is 6/8. The music features various rhythmic patterns, including eighth and sixteenth notes, and rests. The fifth measure (86) is marked with a repeat sign and a first ending bracket.

87

Musical score for measures 87-91. The score is written for five staves. The first staff is in treble clef, the second in treble clef, the third in bass clef, the fourth in bass clef, and the fifth in bass clef. The key signature has one sharp (F#). The time signature is 6/8. The music features various rhythmic patterns, including eighth and sixteenth notes, and rests. The fifth measure (91) is marked with a repeat sign and a first ending bracket.

Musical score for measures 92-96. The score is written for five staves. The first staff is a treble clef staff with a key signature of one flat (B-flat). The second staff is a treble clef staff with a key signature of one flat (B-flat). The third staff is a bass clef staff with a key signature of one flat (B-flat). The fourth staff is a bass clef staff with a key signature of one flat (B-flat). The fifth staff is a bass clef staff with a key signature of one flat (B-flat). The music features various rhythmic patterns, including eighth and sixteenth notes, and rests. There are also some accidentals (sharps and flats) and dynamic markings (accents) throughout the passage.

Musical score for measures 97-101. The score is written for five staves. The first staff is a treble clef staff with a key signature of one flat (B-flat). The second staff is a treble clef staff with a key signature of one flat (B-flat). The third staff is a bass clef staff with a key signature of one flat (B-flat). The fourth staff is a bass clef staff with a key signature of one flat (B-flat). The fifth staff is a bass clef staff with a key signature of one flat (B-flat). The music features various rhythmic patterns, including eighth and sixteenth notes, and rests. There are also some accidentals (sharps and flats) and dynamic markings (accents) throughout the passage.

102

Measures 102-106 of a musical score. The score is written for five staves. The first staff (treble clef) contains the main melody, starting with a half note G4, followed by quarter notes A4, B4, and C5, then a half note D5, and finally a half note E5. The second staff (treble clef) is mostly empty, with a half note G4 in measure 104. The third staff (bass clef) contains a bass line starting with a half note G2, followed by quarter notes A2, B2, and C3, then a half note D3, and finally a half note E3. The fourth staff (bass clef) is mostly empty, with a half note G2 in measure 104. The fifth staff (bass clef) contains a bass line starting with a half note G2, followed by quarter notes A2, B2, and C3, then a half note D3, and finally a half note E3. The key signature has one sharp (F#) and the time signature is 4/4.

107

Measures 107-111 of a musical score. The score is written for five staves. The first staff (treble clef) contains the main melody, starting with a half note G4, followed by quarter notes A4, B4, and C5, then a half note D5, and finally a half note E5. The second staff (treble clef) contains a bass line starting with a half note G2, followed by quarter notes A2, B2, and C3, then a half note D3, and finally a half note E3. The third staff (bass clef) contains a bass line starting with a half note G2, followed by quarter notes A2, B2, and C3, then a half note D3, and finally a half note E3. The fourth staff (bass clef) is mostly empty, with a half note G2 in measure 107. The fifth staff (bass clef) contains a bass line starting with a half note G2, followed by quarter notes A2, B2, and C3, then a half note D3, and finally a half note E3. The key signature has one sharp (F#) and the time signature is 4/4.

112

Musical score for measures 112-117. The score is written for five staves. The first staff is in treble clef, and the others are in bass clef. The time signature is 12/8. The key signature has one flat (B-flat). The score includes dynamic markings: *ppp* (pianississimo) and *pp* (pianissimo). The notation includes various note values, rests, and slurs.

118

Musical score for measures 118-123. The score is written for five staves. The first staff is in treble clef, and the others are in bass clef. The time signature is 12/8. The key signature has one flat (B-flat). The notation includes various note values, rests, and slurs.

123

A musical score for five staves, measures 123-127. The score is written in treble and bass clefs. The key signature is one sharp (F#). The time signature is 6/4, which changes to 4/4 in measures 125 and 127. The notation includes various musical symbols such as notes, rests, and accidentals.

Measure 123: Treble clef, F#4, G4, A4, B4, C5, D5, E5, F#5, G5, A5, B5, C6, D6, E6, F#6, G6, A6, B6, C7, D7, E7, F#7, G7, A7, B7, C8, D8, E8, F#8, G8, A8, B8, C9, D9, E9, F#9, G9, A9, B9, C10, D10, E10, F#10, G10, A10, B10, C11, D11, E11, F#11, G11, A11, B11, C12, D12, E12, F#12, G12, A12, B12, C13, D13, E13, F#13, G13, A13, B13, C14, D14, E14, F#14, G14, A14, B14, C15, D15, E15, F#15, G15, A15, B15, C16, D16, E16, F#16, G16, A16, B16, C17, D17, E17, F#17, G17, A17, B17, C18, D18, E18, F#18, G18, A18, B18, C19, D19, E19, F#19, G19, A19, B19, C20, D20, E20, F#20, G20, A20, B20, C21, D21, E21, F#21, G21, A21, B21, C22, D22, E22, F#22, G22, A22, B22, C23, D23, E23, F#23, G23, A23, B23, C24, D24, E24, F#24, G24, A24, B24, C25, D25, E25, F#25, G25, A25, B25, C26, D26, E26, F#26, G26, A26, B26, C27, D27, E27, F#27, G27, A27, B27, C28, D28, E28, F#28, G28, A28, B28, C29, D29, E29, F#29, G29, A29, B29, C30, D30, E30, F#30, G30, A30, B30, C31, D31, E31, F#31, G31, A31, B31, C32, D32, E32, F#32, G32, A32, B32, C33, D33, E33, F#33, G33, A33, B33, C34, D34, E34, F#34, G34, A34, B34, C35, D35, E35, F#35, G35, A35, B35, C36, D36, E36, F#36, G36, A36, B36, C37, D37, E37, F#37, G37, A37, B37, C38, D38, E38, F#38, G38, A38, B38, C39, D39, E39, F#39, G39, A39, B39, C40, D40, E40, F#40, G40, A40, B40, C41, D41, E41, F#41, G41, A41, B41, C42, D42, E42, F#42, G42, A42, B42, C43, D43, E43, F#43, G43, A43, B43, C44, D44, E44, F#44, G44, A44, B44, C45, D45, E45, F#45, G45, A45, B45, C46, D46, E46, F#46, G46, A46, B46, C47, D47, E47, F#47, G47, A47, B47, C48, D48, E48, F#48, G48, A48, B48, C49, D49, E49, F#49, G49, A49, B49, C50, D50, E50, F#50, G50, A50, B50, C51, D51, E51, F#51, G51, A51, B51, C52, D52, E52, F#52, G52, A52, B52, C53, D53, E53, F#53, G53, A53, B53, C54, D54, E54, F#54, G54, A54, B54, C55, D55, E55, F#55, G55, A55, B55, C56, D56, E56, F#56, G56, A56, B56, C57, D57, E57, F#57, G57, A57, B57, C58, D58, E58, F#58, G58, A58, B58, C59, D59, E59, F#59, G59, A59, B59, C60, D60, E60, F#60, G60, A60, B60, C61, D61, E61, F#61, G61, A61, B61, C62, D62, E62, F#62, G62, A62, B62, C63, D63, E63, F#63, G63, A63, B63, C64, D64, E64, F#64, G64, A64, B64, C65, D65, E65, F#65, G65, A65, B65, C66, D66, E66, F#66, G66, A66, B66, C67, D67, E67, F#67, G67, A67, B67, C68, D68, E68, F#68, G68, A68, B68, C69, D69, E69, F#69, G69, A69, B69, C70, D70, E70, F#70, G70, A70, B70, C71, D71, E71, F#71, G71, A71, B71, C72, D72, E72, F#72, G72, A72, B72, C73, D73, E73, F#73, G73, A73, B73, C74, D74, E74, F#74, G74, A74, B74, C75, D75, E75, F#75, G75, A75, B75, C76, D76, E76, F#76, G76, A76, B76, C77, D77, E77, F#77, G77, A77, B77, C78, D78, E78, F#78, G78, A78, B78, C79, D79, E79, F#79, G79, A79, B79, C80, D80, E80, F#80, G80, A80, B80, C81, D81, E81, F#81, G81, A81, B81, C82, D82, E82, F#82, G82, A82, B82, C83, D83, E83, F#83, G83, A83, B83, C84, D84, E84, F#84, G84, A84, B84, C85, D85, E85, F#85, G85, A85, B85, C86, D86, E86, F#86, G86, A86, B86, C87, D87, E87, F#87, G87, A87, B87, C88, D88, E88, F#88, G88, A88, B88, C89, D89, E89, F#89, G89, A89, B89, C90, D90, E90, F#90, G90, A90, B90, C91, D91, E91, F#91, G91, A91, B91, C92, D92, E92, F#92, G92, A92, B92, C93, D93, E93, F#93, G93, A93, B93, C94, D94, E94, F#94, G94, A94, B94, C95, D95, E95, F#95, G95, A95, B95, C96, D96, E96, F#96, G96, A96, B96, C97, D97, E97, F#97, G97, A97, B97, C98, D98, E98, F#98, G98, A98, B98, C99, D99, E99, F#99, G99, A99, B99, C100, D100, E100, F#100, G100, A100, B100, C101, D101, E101, F#101, G101, A101, B101, C102, D102, E102, F#102, G102, A102, B102, C103, D103, E103, F#103, G103, A103, B103, C104, D104, E104, F#104, G104, A104, B104, C105, D105, E105, F#105, G105, A105, B105, C106, D106, E106, F#106, G106, A106, B106, C107, D107, E107, F#107, G107, A107, B107, C108, D108, E108, F#108, G108, A108, B108, C109, D109, E109, F#109, G109, A109, B109, C110, D110, E110, F#110, G110, A110, B110, C111, D111, E111, F#111, G111, A111, B111, C112, D112, E112, F#112, G112, A112, B112, C113, D113, E113, F#113, G113, A113, B113, C114, D114, E114, F#114, G114, A114, B114, C115, D115, E115, F#115, G115, A115, B115, C116, D116, E116, F#116, G116, A116, B116, C117, D117, E117, F#117, G117, A117, B117, C118, D118, E118, F#118, G118, A118, B118, C119, D119, E119, F#119, G119, A119, B119, C120, D120, E120, F#120, G120, A120, B120, C121, D121, E121, F#121, G121, A121, B121, C122, D122, E122, F#122, G122, A122, B122, C123, D123, E123, F#123, G123, A123, B123, C124, D124, E124, F#124, G124, A124, B124, C125, D125, E125, F#125, G125, A125, B125, C126, D126, E126, F#126, G126, A126, B126, C127, D127, E127, F#127, G127, A127, B127, C128, D128, E128, F#128, G128, A128, B128, C129, D129, E129, F#129, G129, A129, B129, C130, D130, E130, F#130, G130, A130, B130, C131, D131, E131, F#131, G131, A131, B131, C132, D132, E132, F#132, G132, A132, B132, C133, D133, E133, F#133, G133, A133, B133, C134, D134, E134, F#134, G134, A134, B134, C135, D135, E135, F#135, G135, A135, B135, C136, D136, E136, F#136, G136, A136, B136, C137, D137, E137, F#137, G137, A137, B137, C138, D138, E138, F#138, G138, A138, B138, C139, D139, E139, F#139, G139, A139, B139, C140, D140, E140, F#140, G140, A140, B140, C141, D141, E141, F#141, G141, A141, B141, C142, D142, E142, F#142, G142, A142, B142, C143, D143, E143, F#143, G143, A143, B143, C144, D144, E144, F#144, G144, A144, B144, C145, D145, E145, F#145, G145, A145, B145, C146, D146, E146, F#146, G146, A146, B146, C147, D147, E147, F#147, G147, A147, B147, C148, D148, E148, F#148, G148, A148, B148, C149, D149, E149, F#149, G149, A149, B149, C150, D150, E150, F#150, G150, A150, B150, C151, D151, E151, F#151, G151, A151, B151, C152, D152, E152, F#152, G152, A152, B152, C153, D153, E153, F#153, G153, A153, B153, C154, D154, E154, F#154, G154, A154, B154, C155, D155, E155, F#155, G155, A155, B155, C156, D156, E156, F#156, G156, A156, B156, C157, D157, E157, F#157, G157, A157, B157, C158, D158, E158, F#158, G158, A158, B158, C159, D159, E159, F#159, G159, A159, B159, C160, D160, E160, F#160, G160, A160, B160, C161, D161, E161, F#161, G161, A161, B161, C162, D162, E162, F#162, G162, A162, B162, C163, D163, E163, F#163, G163, A163, B163, C164, D164, E164, F#164, G164, A164, B164, C165, D165, E165, F#165, G165, A165, B165, C166, D166, E166, F#166, G166, A166, B166, C167, D167, E167, F#167, G167, A167, B167, C168, D168, E168, F#168, G168, A168, B168, C169, D169, E169, F#169, G169, A169, B169, C170, D170, E170, F#170, G170, A170, B170, C171, D171, E171, F#171, G171, A171, B171, C172, D172, E172, F#172, G172, A172, B172, C173, D173, E173, F#173, G173, A173, B173, C174, D174, E174, F#174, G174, A174, B174, C175, D175, E175, F#175, G175, A175, B175, C176, D176, E176, F#176, G176, A176, B176, C177, D177, E177, F#177, G177, A177, B177, C178, D178, E178, F#178, G178, A178, B178, C179, D179, E179, F#179, G179, A179, B179, C180, D180, E180, F#180, G180, A180, B180, C181, D181, E181, F#181, G181, A181, B181, C182, D182, E182, F#182, G182, A182, B182, C183, D183, E183, F#183, G183, A183, B183, C184, D184, E184, F#184, G184, A184, B184, C185, D185, E185, F#185, G185, A185, B185, C186, D186, E186, F#186, G186, A186, B186, C187, D187, E187, F#187, G187, A187, B187, C188, D188, E188, F#188, G188, A188, B188, C189, D189, E189, F#189, G189, A189, B189, C190, D190, E190, F#190, G190, A190, B190, C191, D191, E191, F#191, G191, A191, B191, C192, D192, E192, F#192, G192, A192, B192, C193, D193, E193, F#193, G193, A193, B193, C194, D194, E194, F#194, G194, A194, B194, C195, D195, E195, F#195, G195, A195, B195, C196, D196, E196, F#196, G196, A196, B196, C197, D197, E197, F#197, G197, A197, B197, C198, D198, E198, F#198, G198, A198, B198, C199, D199, E199, F#199, G199, A199, B199, C200, D200, E200, F#200, G200, A200, B200, C201, D201, E201, F#201, G201, A201, B201, C202, D202, E202, F#202, G202, A202, B202, C203, D203, E203, F#203, G203, A203, B203, C204, D204, E204, F#204, G204, A204, B204, C205, D205, E205, F#205, G205, A205, B205, C206, D206, E206, F#206, G206, A206, B206, C207, D207, E207, F#207, G207, A207, B207, C208, D208, E208, F#208, G208, A208, B208, C209, D209, E209, F#209, G209, A209, B209, C210, D210, E210, F#210, G210, A210, B210, C211, D211, E211, F#211, G211, A211, B211, C212, D212, E212, F#212, G212, A212, B212, C213, D213, E213, F#213, G213, A213, B213, C214, D214, E214, F#214, G214, A214, B214, C215, D215, E215, F#215, G215, A215, B215, C216, D216, E216, F#216, G216, A216, B216, C217, D217, E217, F#217, G217, A217, B217, C218, D218, E218, F#218, G218, A218, B218, C219, D219, E219, F#219, G219, A219, B219, C220, D220, E220, F#220, G220, A220, B220, C221, D221, E221, F#221, G221, A221, B221, C222, D222, E222, F#222, G222, A222, B222, C223, D223, E223, F#223, G223, A223, B223, C224, D224, E224, F#224, G224, A224, B224, C225, D225, E225, F#225, G225, A225, B225, C226, D226, E226, F#226, G226, A226, B226, C227, D227, E227, F#227, G227, A227, B227, C228, D228, E228, F#228, G228, A228, B228, C229, D229, E229, F#229, G229, A229, B229, C230, D230, E230, F#230, G230, A230, B230, C231, D231, E231, F#231, G231, A231, B231, C232, D232, E232, F#232, G232, A232, B232, C233, D233, E233, F#233, G233, A233, B233, C234, D234, E234, F#234, G234, A234, B234, C235, D235, E235, F#235, G235, A235, B235, C236, D236, E236, F#236, G236, A236, B236, C237, D237, E237, F#237, G237, A237, B237, C238, D238, E238, F#238, G238, A238, B238, C239, D239, E239, F#239, G239, A239, B239, C240, D240, E240, F#240, G240, A240, B240, C241, D241, E241, F#241, G241, A241, B241, C242, D242, E242, F#242, G242, A242, B242, C243, D243, E243, F#243, G243, A243, B243, C244, D244, E244, F#244, G244, A244, B244, C245, D245, E245, F#245, G245, A245, B245, C246, D246, E246, F#246, G246, A246, B246, C247, D247, E247, F#247, G247, A247, B247, C248, D248, E248, F#248, G248, A248, B248, C249, D249, E249, F#249, G249, A249, B249, C250, D250, E250, F#250, G250, A250, B250, C251, D251, E251, F#251, G251, A251, B251, C252, D252, E252, F#252, G252, A252, B252, C253, D253, E253, F#253, G253, A253, B253, C254, D254, E254, F#254, G254, A254, B254, C255, D255, E255, F#255, G255, A255, B255, C256, D256, E256, F#256, G256, A256, B256, C257, D257, E257, F#257, G257, A257, B257, C258, D258, E258, F#258, G258, A258, B258, C259, D259, E259, F#259, G259, A259, B259, C260, D260, E260, F#260, G260, A260, B260, C261, D261, E261, F#261, G261, A261, B261, C262, D262, E262, F#262, G262, A262, B262, C263, D263, E263, F#263, G263, A263, B263, C264, D264, E264, F#264, G264, A264, B264, C265, D265, E265, F#265, G265, A265, B265, C266, D266, E266, F#266, G266, A266, B266, C267, D267, E267, F#267, G267, A267, B267, C268, D268, E268, F#268, G268, A268, B268, C269, D269, E269, F#269, G269, A269, B269, C270, D270, E270, F#270, G270, A270, B270, C271, D271, E271, F#271, G271, A271, B271, C272, D272, E272, F#272, G272, A272, B272, C273, D273, E273, F#273, G273, A273, B273, C274, D274, E274, F#274, G274, A274, B274, C275, D275, E275, F#275, G275, A275, B275, C276, D276, E276, F#276, G276, A276, B276, C277, D277, E277, F#277, G277, A277, B277, C278, D278, E278, F#278, G278, A278, B278, C279, D279, E279, F#279, G279, A279, B279, C280, D280, E280, F#280, G280, A280, B280, C281, D281, E281, F#281, G281, A281, B281, C282, D282, E282, F#282, G282, A282, B282, C283, D283, E283, F#283, G283, A283, B283, C284, D284, E284, F#284, G284, A284, B284, C285, D285, E285, F#285, G285, A285, B285, C286, D286, E286, F#286, G286, A286, B286, C287, D287, E287, F#287, G287, A287, B287, C288, D288, E288, F#288, G288, A288, B288, C289, D289, E289, F#289, G289, A289, B289, C290, D290, E290, F#290, G290, A290, B290, C291, D291, E291, F#291, G291, A291, B291, C292, D292, E292, F#292, G292, A292, B292, C293, D293, E293, F#293, G293, A293, B293, C294, D294, E294, F#294, G294, A294, B294, C295, D295, E295, F#295, G295, A295, B295, C296, D296, E296, F#296, G296, A296, B296, C297, D297, E297, F#297, G297, A297, B297, C298, D298, E298, F#298, G298, A298, B298, C299, D299, E299, F#299, G299, A299, B299, C300, D300, E300, F#300, G300, A300, B300, C301, D301, E301, F#301, G301, A301, B301, C302, D302, E302, F#302, G302, A302, B302, C303, D303, E303, F#303, G303, A303, B303, C304, D304, E304, F#304, G304, A304, B304, C305, D305, E305, F#305, G305, A305, B305, C306, D306, E306, F#306, G306, A306, B306, C307, D307, E307, F#307, G307, A307, B307, C308, D308, E308, F#308, G308, A308, B308, C309, D309, E309, F#309, G309, A309, B309, C310, D310, E310, F#310, G310, A310, B310, C311, D311, E311, F#311, G311, A311, B311, C312, D312, E312, F#312, G312, A312, B312, C313, D313, E313, F#313, G313, A313, B313, C314, D314, E314, F#314, G314, A314, B314, C315, D315, E315, F#315, G315, A315, B315, C316, D316, E316, F#316, G316, A316, B316, C317, D317, E317, F#317, G317, A317, B317, C318, D318, E318, F#318, G318, A318, B318, C319, D319, E319, F#319, G319, A319, B319, C320, D320, E320, F#320, G320, A320, B320, C321, D321, E321, F#321, G321, A321, B321, C322, D322, E322, F#322, G322, A322, B322, C323, D323, E323, F#323, G323, A323, B323, C324, D324, E324, F#324, G324, A324, B324, C325, D325, E325, F#325, G325, A325, B325, C326, D326, E326, F#326, G326, A326, B326, C327, D327, E327, F#327, G327, A327, B327, C328, D328, E328, F#328, G328, A328, B328, C329, D329, E329, F#329, G329, A329, B329, C330, D330, E330, F#330, G330, A330, B330, C331, D331, E331, F#331, G331, A331, B331, C332, D332, E332, F#332, G332, A332, B332, C333, D333, E333, F#333, G333, A333, B333, C334, D334, E334, F#334, G334, A334, B334, C335, D335, E335, F#335, G335, A335, B335, C336, D336, E336, F#336, G336, A336, B336, C337, D337, E337, F#337, G337, A337, B337, C338, D338, E338, F#338, G338, A338, B338, C339, D339, E339, F#339, G339, A339, B339, C340, D340, E340, F#340, G340, A340, B340, C341, D341, E341, F#341, G341, A341, B341, C342, D342, E342, F#342, G342, A342, B342, C343, D343, E343, F#343, G343, A343, B343, C344, D344, E344, F#344, G344, A344, B344, C345, D345, E345, F#345, G345, A345, B345, C346, D346, E346, F#346, G346, A346, B346, C347, D347, E347, F#347, G347, A347, B347, C348, D348, E348, F#348, G348, A348, B348, C349, D349, E349, F#349, G349, A349, B349, C350, D350, E350, F#350, G350, A350, B350, C351, D351, E351, F#351, G351, A351, B351, C352, D352, E352, F#352, G352, A352, B352, C353, D353, E353, F#353, G353, A353, B353, C354, D354, E354, F#354, G354, A354, B354, C355, D355, E355, F#355, G355, A355, B355, C356, D356, E356, F#356, G356, A356, B356, C357, D357, E357, F#357, G357, A357, B357, C358, D358, E358, F#358, G358, A358, B358, C359, D359, E359, F#359, G359, A359, B359, C360, D360, E360, F#360, G360, A360, B360, C361, D361, E361, F#361, G361, A361, B361, C362, D362, E