Bach-In-The-Mirror, A Symmetrically-Inverted edition of the Bach Two Part Inventions (for playing on a **Kundalini Piano**)

Benjamin Pritchard, after Johann Sebastian Bach

January 28, 2024

Dedication

This symmetrically-inverted edition of the Bach Two Part Inventions is dedicated to my teacher and friend, **Nicholas Constantinidis**– *the most self-actualized human being I have ever known.*

Introduction

The two part inventions are a series of keyboard exercises by Johann Sebastian Bach written in two part counterpoint; they were collected together into the book Klavierbüchlein für Wilhelm Friedemann Bach. Bach titled the collection:

> Forthright instruction, wherewith lovers of the clavier, especially those desirous of learning, are shown in a clear way not only 1) to learn to play two voices clearly, but also after further progress 2) to deal correctly and well with three

obbligato parts, moreover at the same time to obtain not only good ideas, but also to carry them out well, but most of all to achieve a cantabile style of playing, and thereby to acquire a strong foretaste of composition.

This edition of the Bach two part inventions are part of the **Kundalini Piano Method**, a novel ambidexterity-based method of piano pedagogy which helps to facilitate ambidexterity and full brain development by facilitating symmetrically-inverted mirror-image keyboard playing. These pieces are designed to be played on a **Kundalini Piano**[1], and were prepared using the **Mozart Transposition Engine**[2]**.**

The Kundalini Piano makes it possible to either mirror left-handed passages into the right hand, mirror right-handed passages into the left hand, or to completely reverse the keyboard such that the left hand plays the original right-hand part in mirror image, while the left hand simultaneously plays the original right-hand part in mirror image. These three remapping types are referred to as **Left Hand Ascending Mode**, **Right Hand Descending Mode**, and **Mirror Image Mode**.

This collection contains each of the original Bach Two Part Inventions notated in each of these modes.

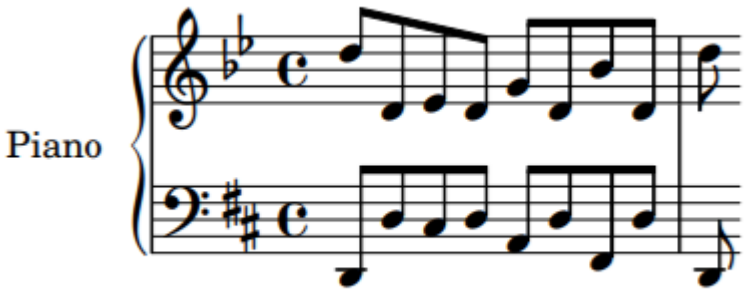
Symmetrical Inversion

The Kundalini Piano Mirror software program is designed to facilitate keyboard playing using symmetrical inversion. This means that either one or both hands are going to be playing the mirror image of what they normally would.

This is possible because the piano keyboard (as well as our hands!) are symmetrical:

Symmetrically-Inverted Notation

Symmetrically-Inverted Notation is simply notation in which one clef is written in standard notation, while the other clef is written using symmetrical inversion, or mirror image:

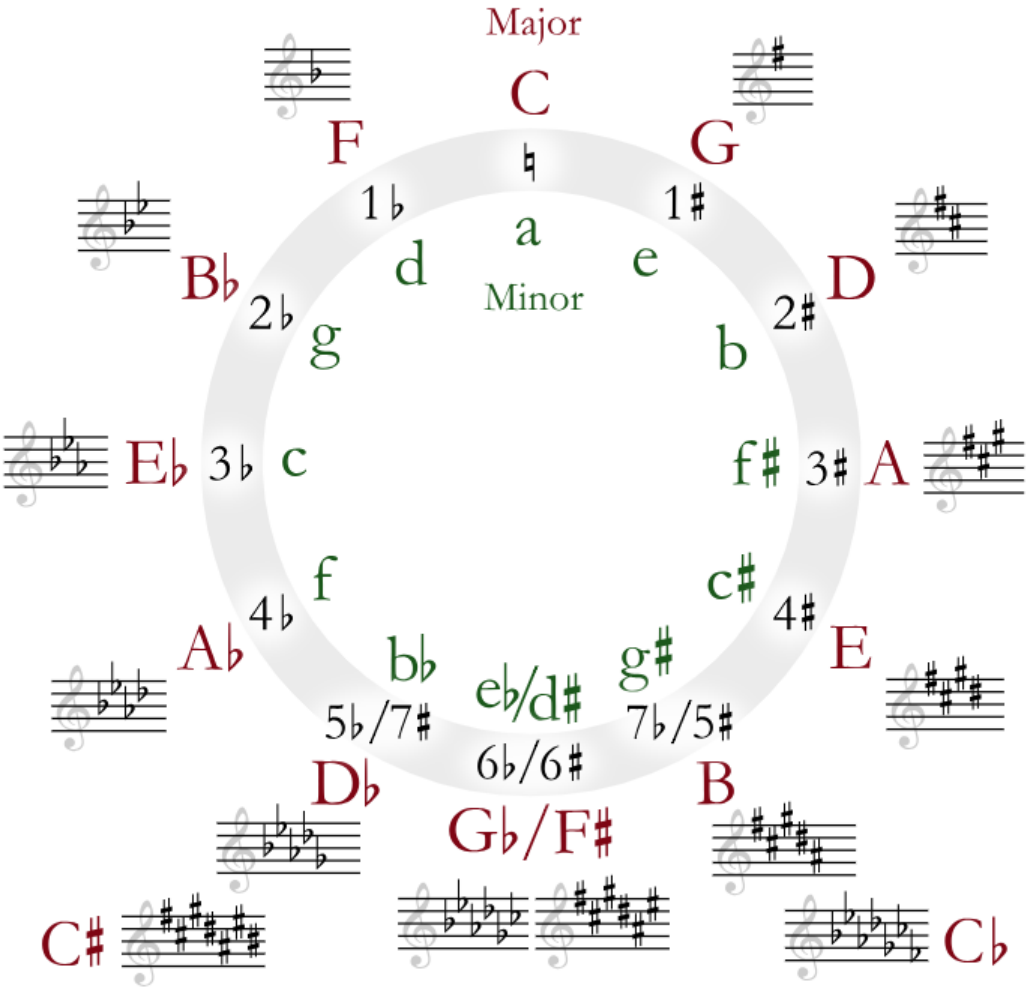


The example above shows a D-Major chord pattern notated in standard notation in the left hand, but notated using symmetrically-inverted notation in the right hand: each note in the right hand is the mirror image of the original note in the left hand.

[1] https://www.kundalinisoftware.com/piano-mirror/
[2] https://www.kundalinisoftware.com/mozart-transposition-engine/

Further, the clef written using symmetrical inversion is notated using a key signature which has the same number of sharps as the clef in standard notation has flats, or, the same number of flats as the clef in standard notation has sharps, if the clef in standard notation is written using sharps.

Consulting the circle of fifths can help us understand this, because it can be seen that for each key, there is a corresponding key that both features the same number of accidentals, and whose pattern of accidentals is the mirror image of the original key's:



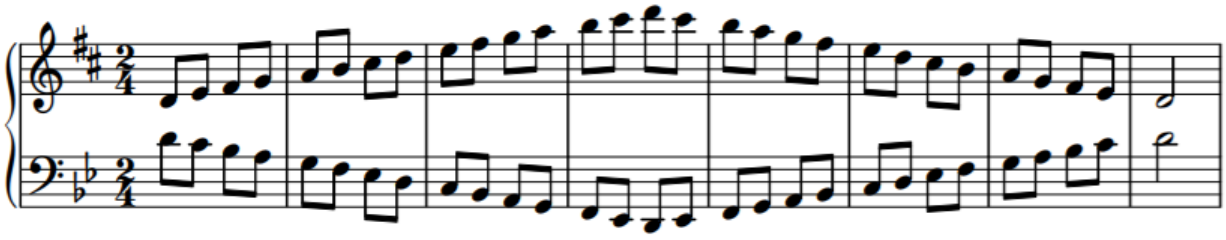
Left Hand Ascending Mode

Left Hand Descending Mode is designed to practice right hand passages using the left hand, while simultaneously playing the original right hand part with the right hand, such that the right hand guides the left hand naturally.

Normally, when we play a standard piano, as our left hand moves further down (to the left) on the piano, we hear lower notes. Left Hand Ascending Mode, on the other hand, changes this behavior. This mode splits the piano into two halves, separated at what is called the keyboard split point. The keyboard split point defaults to middle D.

Any note above (to the right of) the split point is not changed. Any note below (to the left of) the split point is remapped to correspond to the note an equal interval distance above (to the right of) middle d.

Consider the following musical explanation:



The example above is a standard D Major scale, but notated using symmetrically-inverted notation as described above.

As you can see, both hands start on Middle D, and then proceed at equidistant intervals from that point in both directions. When played on a piano keyboard, this has the interesting property of allowing the two hands to play exactly in mirror image, with the same fingers always being used in each hand on exactly the same interval pattern of white and black keys.

When played on a piano with standard tuning, obviously this produces strange sounds because the intervals between the notes are constantly changing. However, when the passage above is played with Left Hand Ascending Mode active, the pitches sound in unison, as though only the right hand part is being played.

Another way to read the above notation is to consider the bass clef part as specifying only which physical key to play on the keyboard, while the treble indicates both the physical key to play and the produced pitch.

Right Hand Descending Mode

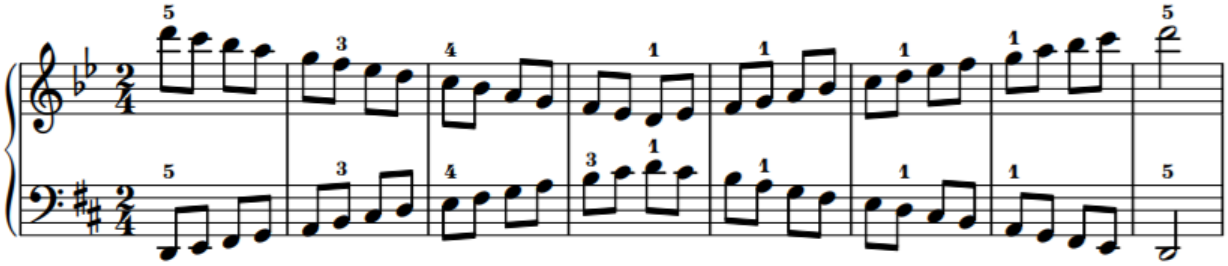
Right Hand Descending Mode is similar to Left Hand Ascending Mode, but is the inverse.

Right Hand Descending Mode is designed to practice left hand passages using the right hand, while simultaneously playing the original left hand part with the left hand, such that the left hand guides the right hand naturally.

Normally, when we play a standard piano, as our right hand moves further up (to the right) on the piano, we hear higher notes. Right Hand Descending Mode, on the other hand, changes this behavior. This mode also splits the piano into two halves, again separated at what is called the keyboard split point, and which again always defaults to middle D.

Any note below (to the left of) the split point is not changed. Any note above (to the right of) the split point is remapped to correspond to the note an equal interval distance below (to the left of) the split point.

The following musical example makes this clear; this time it uses standard notation for the left hand, and symmetrically-inverted notation for the right:

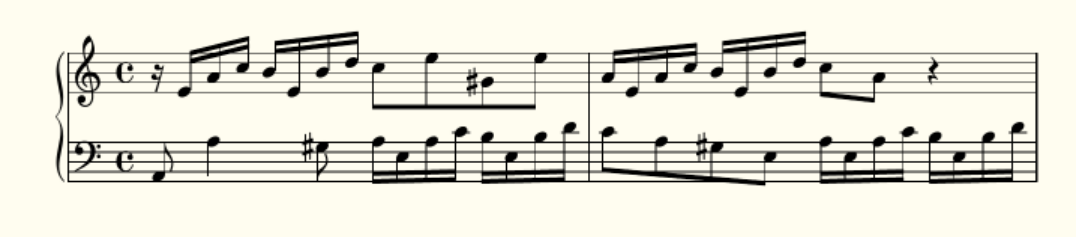


Mirror Image Mode

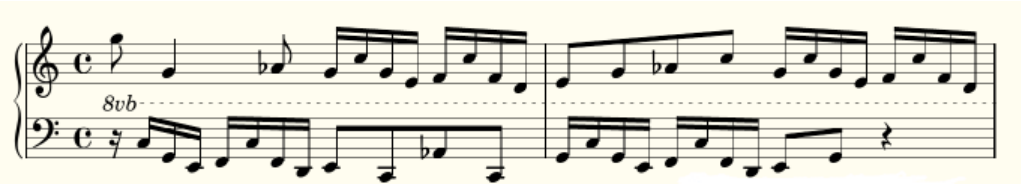
Finally, mirror image mode is designed create what could be called a left-handed piano. In this mode, the entire keyboard is inverted, such that low notes start on the extreme right, and become higher all the way to the extreme left.

In this configuration, it is possible to play the mirror image of the original right-hand part with the left hand, while simultaneously playing the mirror image of the original left-hand part with the right hand.

Consider the following musical example, written using standard notation:



Using Mirror Image Mode, it could be played in the following way:



About this Book

Other than the image on the cover, this book was created entirely using Open Source Software.

The Bach Two Part Inventions used were notated in **GNU Lilypond**[3] format by **Mutopia**[4] contributors **Jeff Covey**, **Allen Garvin**, and **Urs Metzger;** all are in the public domain.

The tranpositions of Bach's inventions were created with custom-developed Python scripts I created for producing transposed, mirror image scores; I call it my **Mozart Transposition Engine**[5].

The image used on the cover page was generated by the **DALL-E** image generator from **OpenAI**.

The table of contents was created using **Libre Office**, using score excerpts sourced from Wikipedia which are licensed as **Attribuition ShareAlike 2.5**.

The real-time MIDI transposition software that allows these inventions to be playable in mirror image on a Digital Piano is called the **Kundalini Piano Mirror**, and is available on my website[6] and through Github[7], and was originally funded via generous grants from the **National Science Foundation** and the **Burton D. Morgan Foundation** via the NSF ICorp Sites Program adminstered by the **University of Akron Research Foundation**; additional funding was also provided by the **No Starch Press Foundation**.

The fingerings [currently only included in the initial measures of Invention No. 1] have been created using the **piano_fingering**[8] Python library, which was written by **Philip Abbet**[9].

The **LyX Document Processor** was used to create the combined .PDF file used to create the printed edition of this book.

[3] https://lilypond.org/
[4] https://www.ibiblio.org/mutopia/
[5] https://github.com/BenjaminPritchard/bach-in-the-mirror
[6] https://www.kundalinisoftware.com/piano-mirror/
[7] https://github.com/KundaliniSoftware/PianoMirror
[8] https://pypi.org/project/piano_fingering/
[9] https://www.idiap.ch/~pabbet/

Online Edition

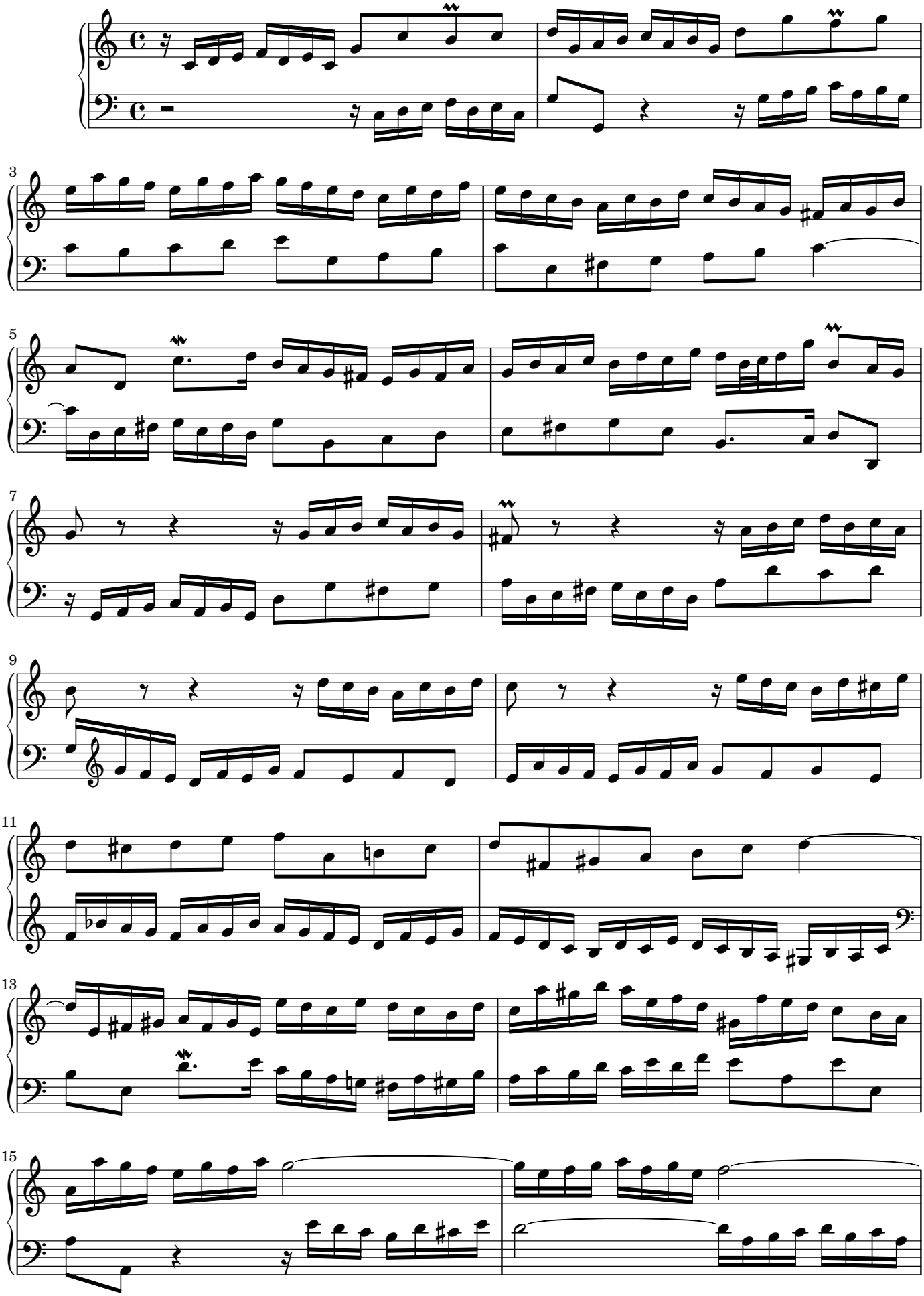
This book also has an on-line edition which features additional transpositions of this material: each of the inventions and its symmetrical inversions are notated into all twelve keys. The online edition is available at https://kundalinisoftware.com/bach-in-the-mirror, and was hand-coded in HTML and vanilla Javascript.

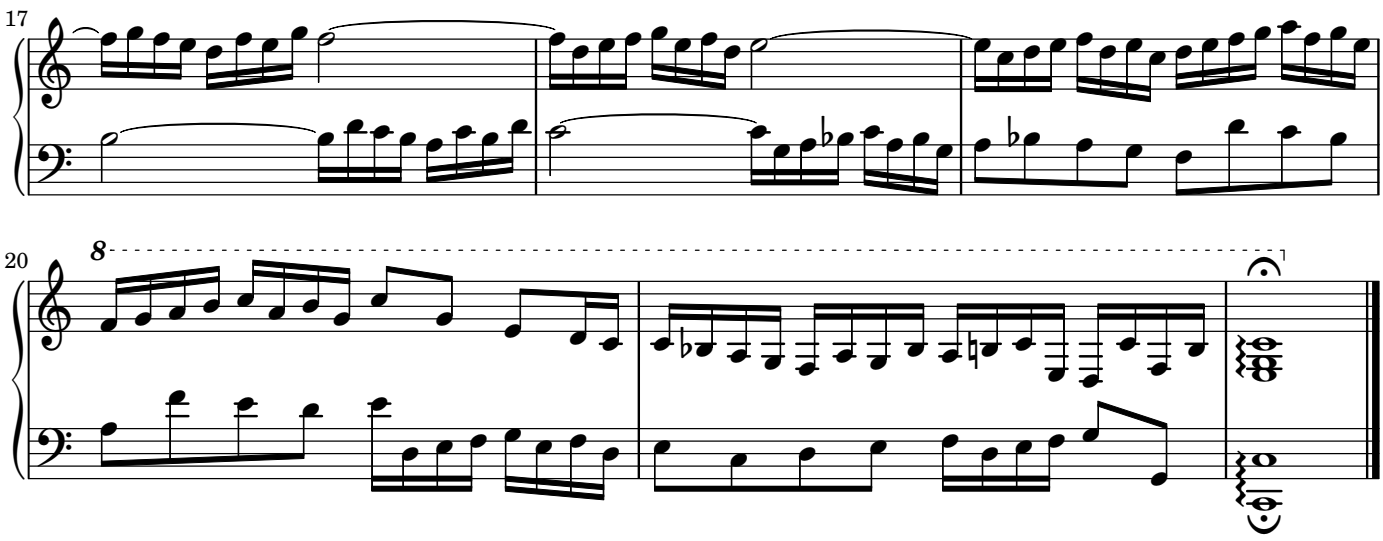
TABLE OF CONTENTS

The remainder of this book contains each of the 15 Bach two part inventions notated in the standard way, plus Left Hand Ascending Mode, Right Hand Descending Mode, and Mirror Image Mode.

Invention 1, BWV 772

Johann Sebastian Bach

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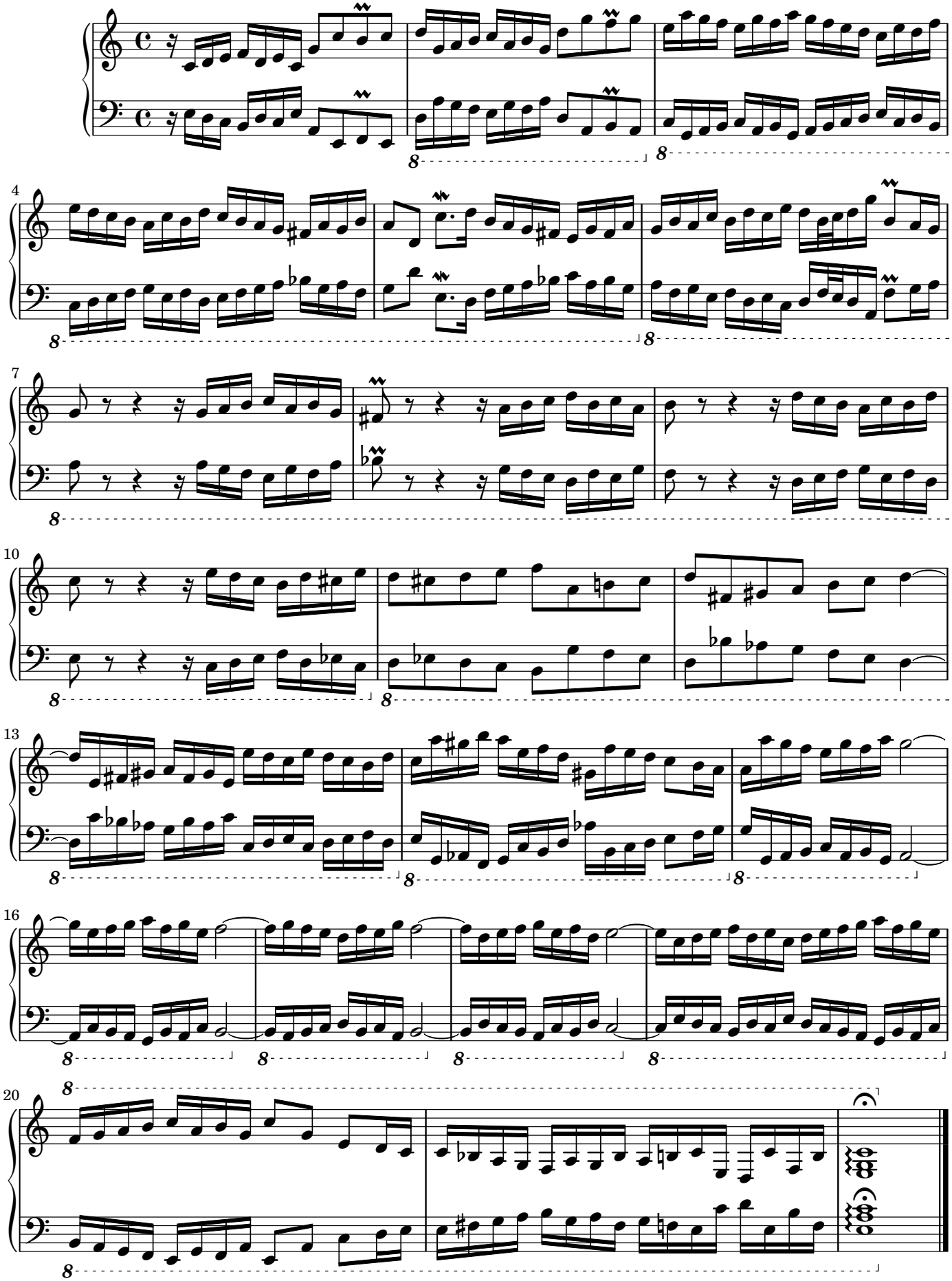
Invention 1, BWV 772

Benjamin Pritchard, after Johann Sebastian Bach

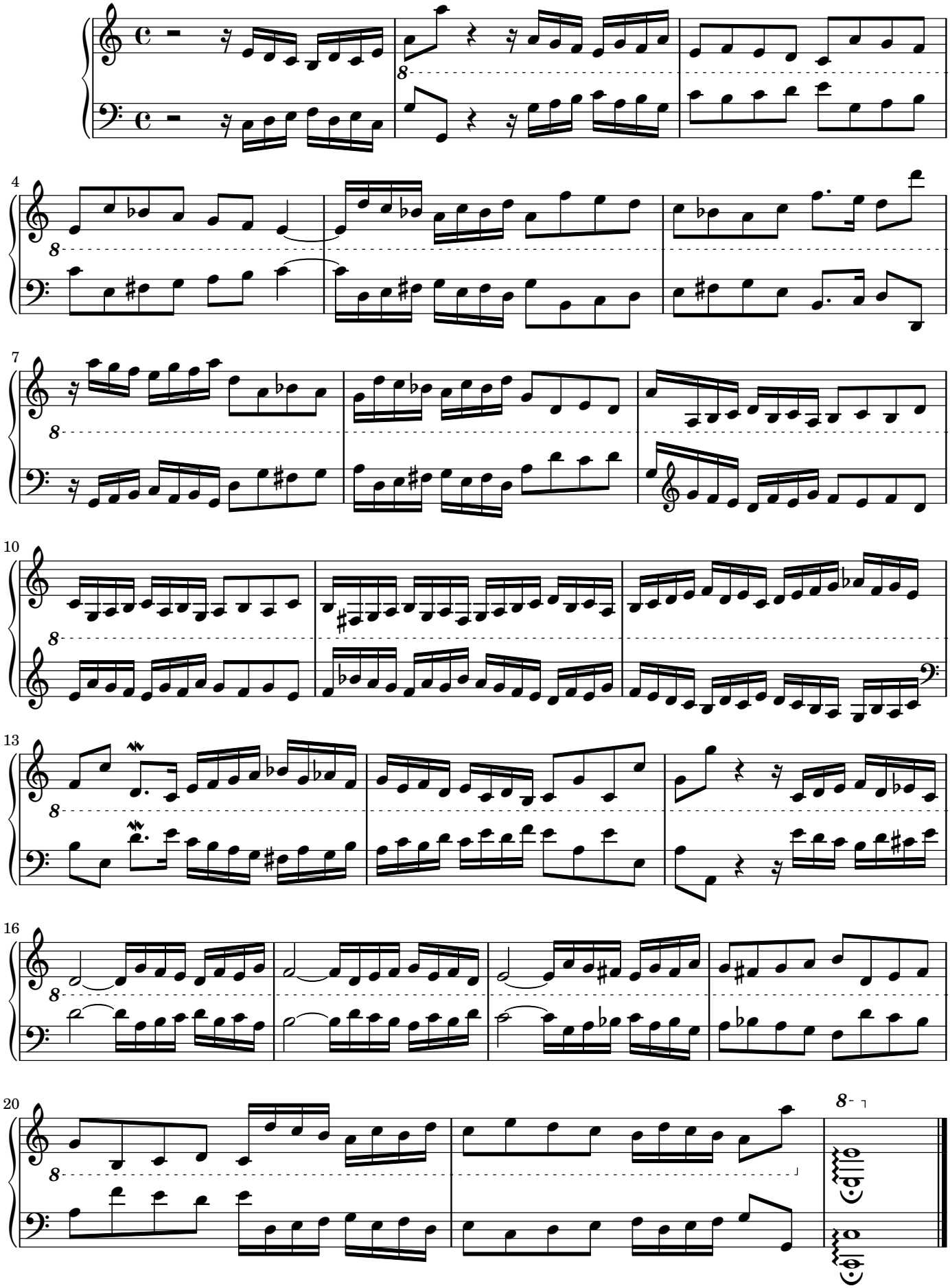
Left Hand Ascending



Invention 1, BWV 772

Benjamin Pritchard, after Johann Sebastian Bach

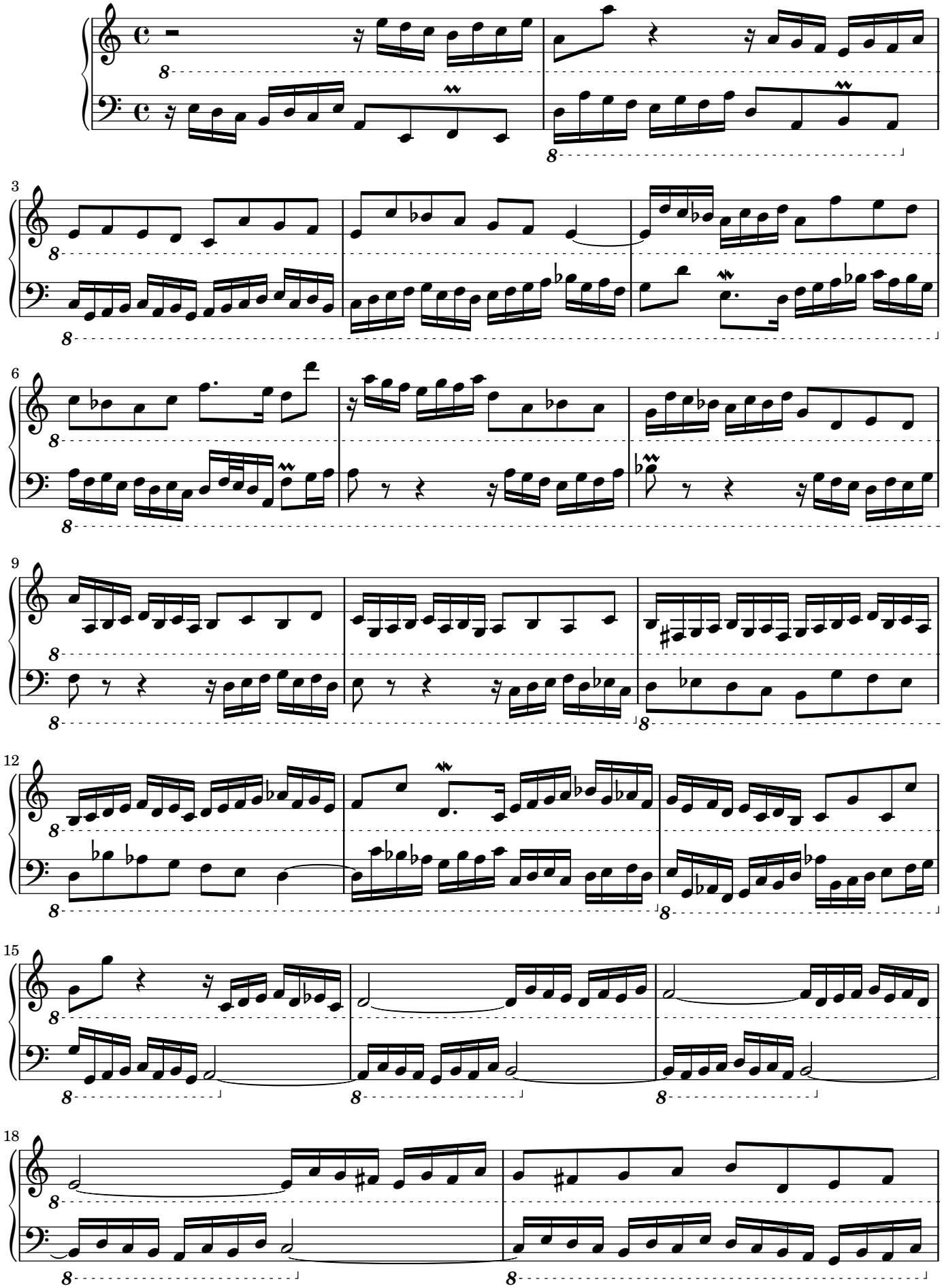
Right Hand Descending

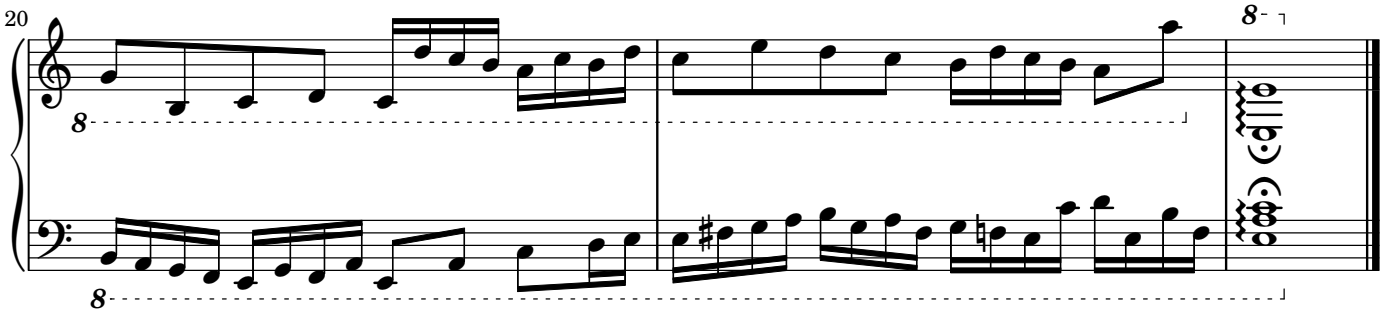


Invention 1, BWV 772

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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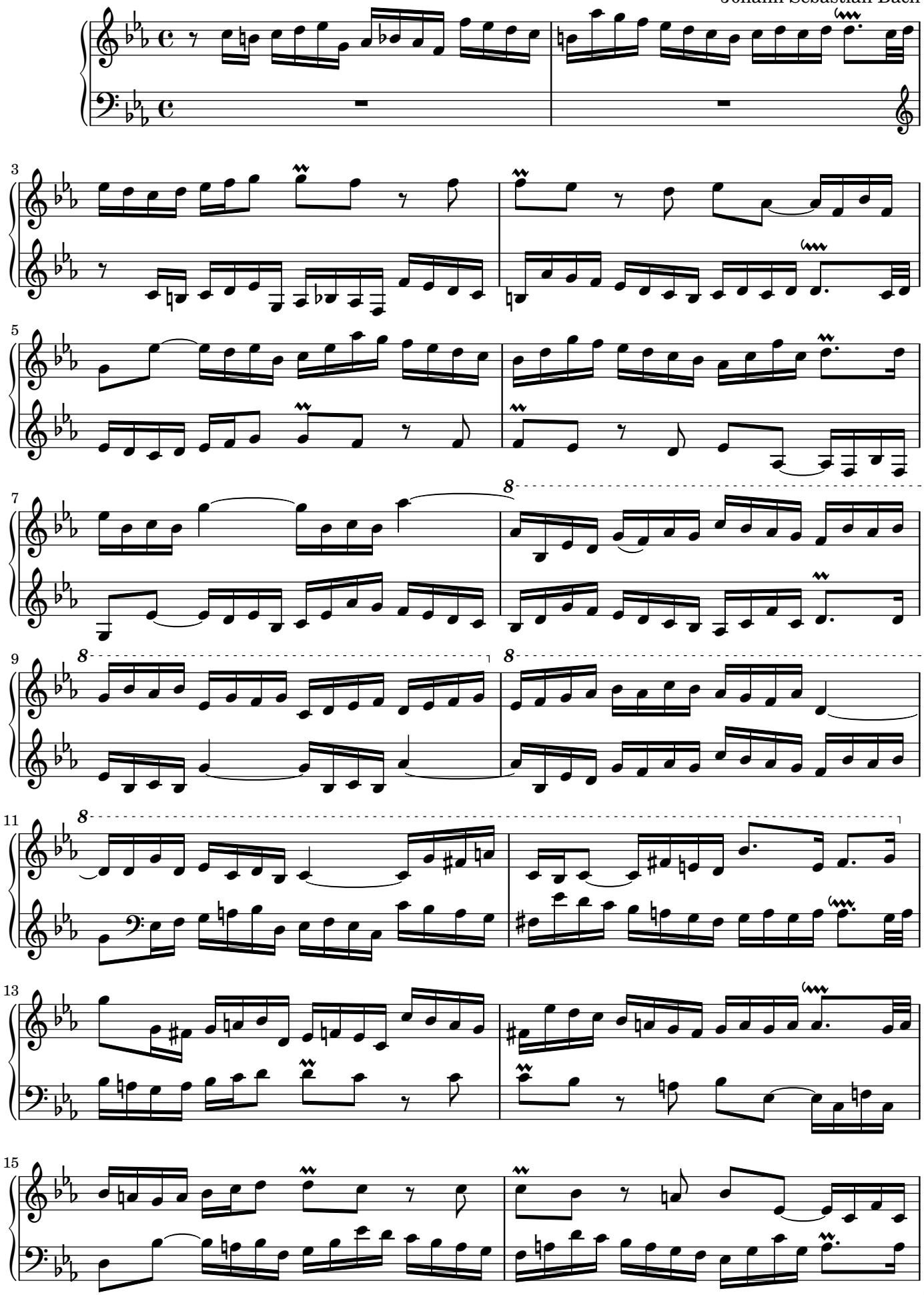
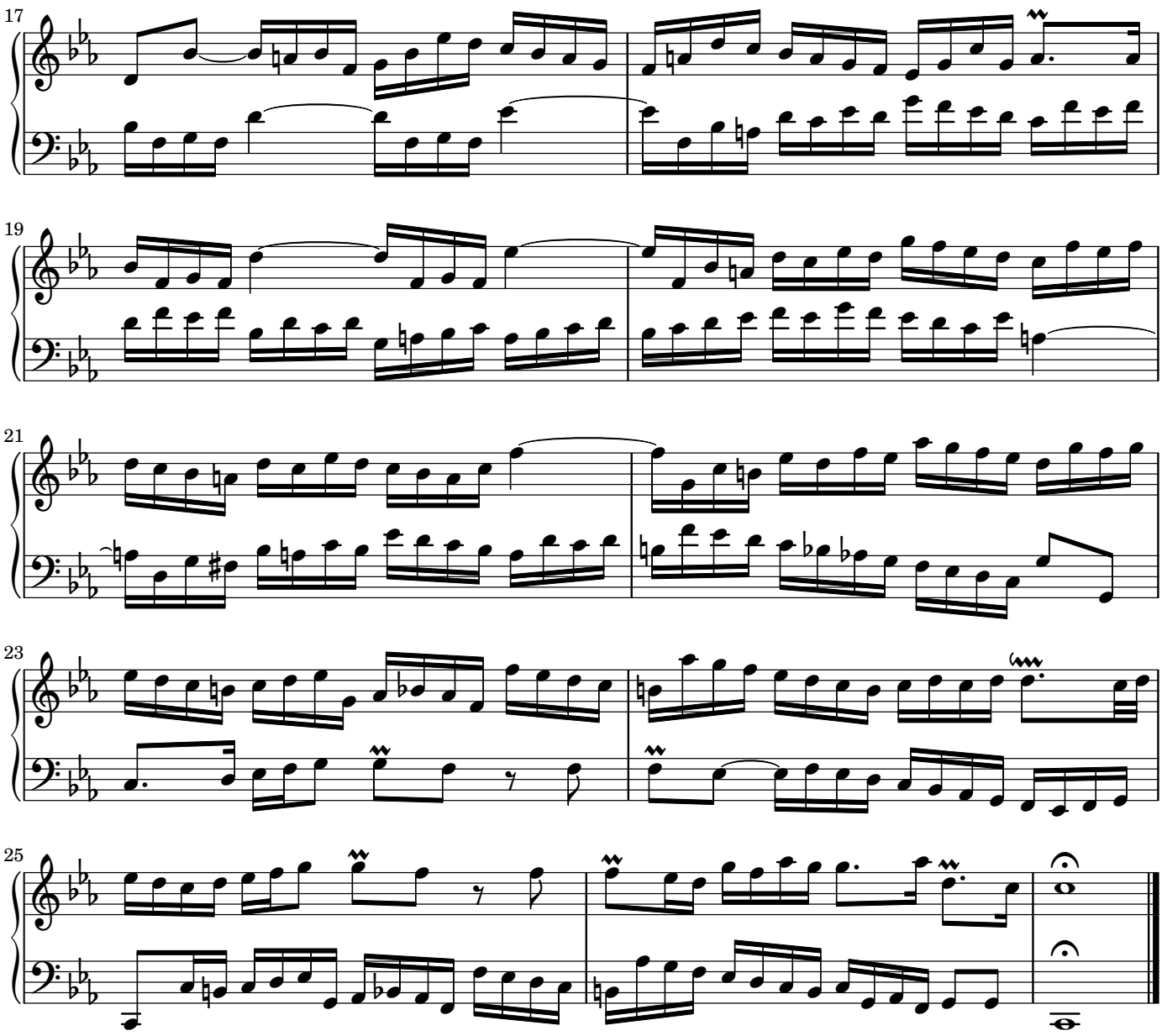
Invention 2, BWV 773

Johann Sebastian Bach

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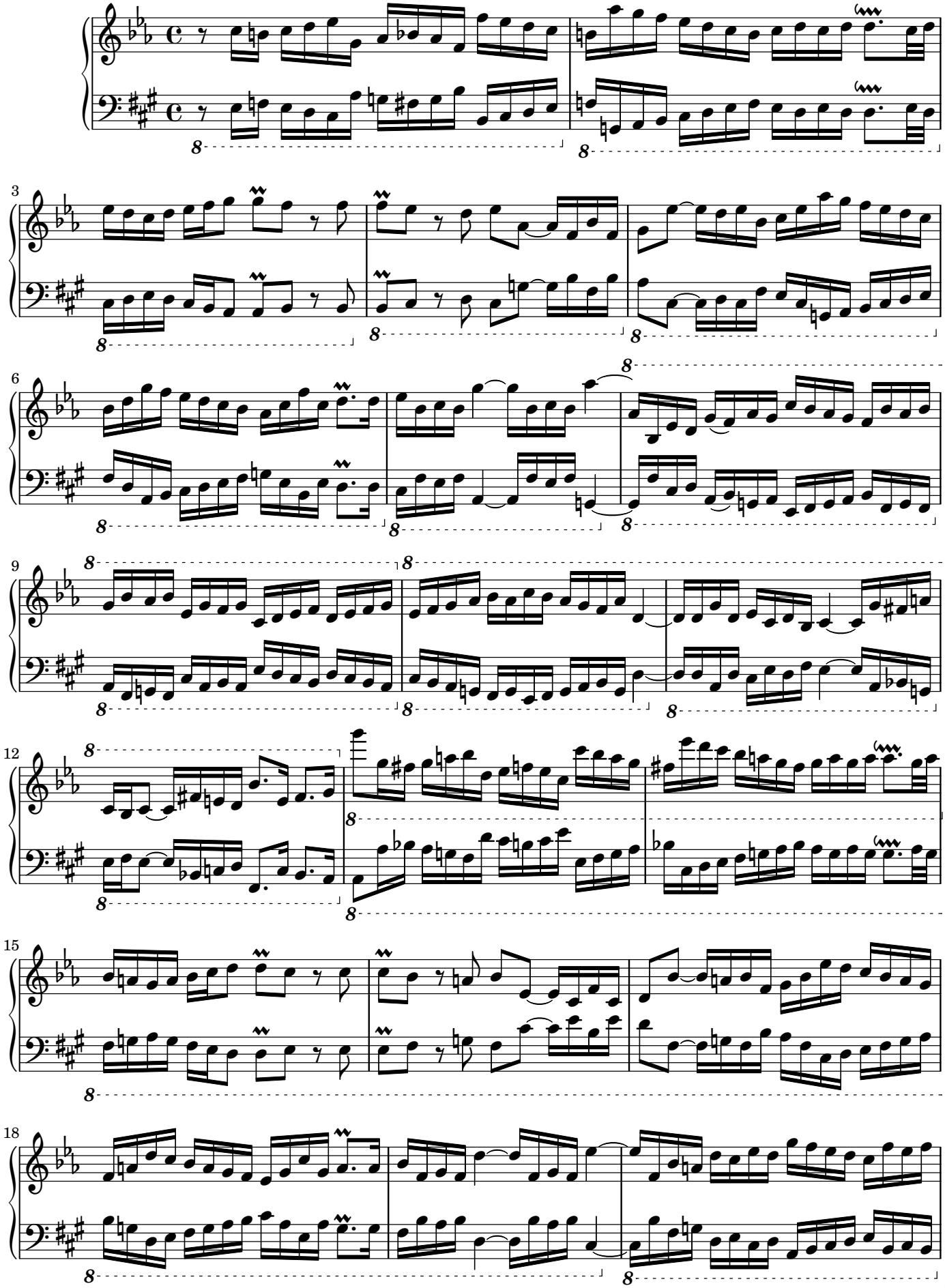
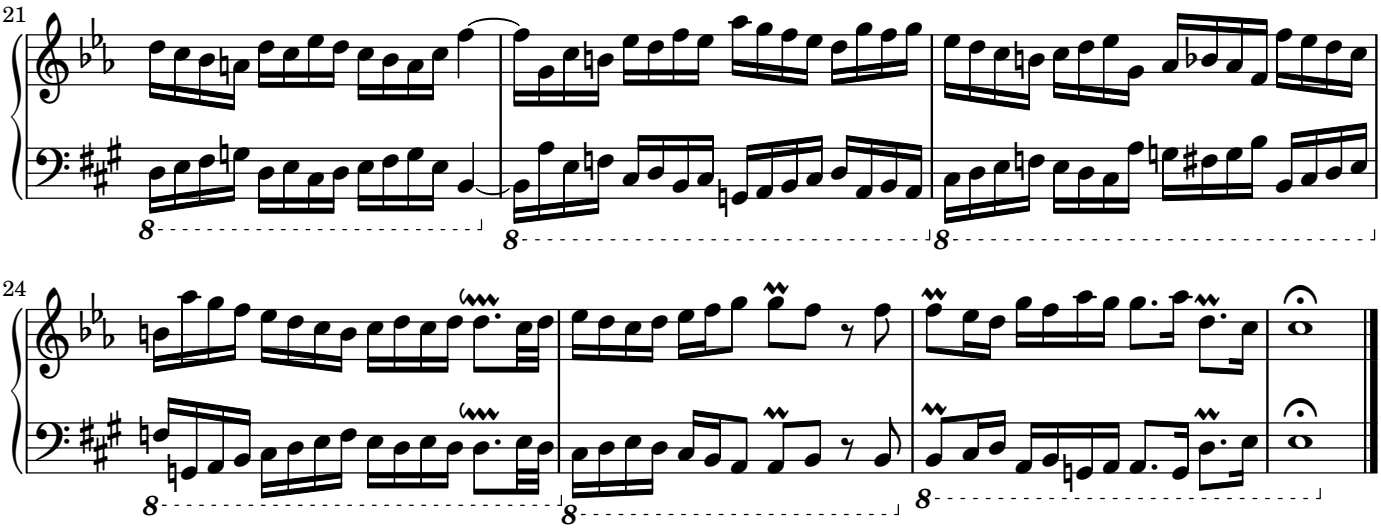
Invention 2, BWV 773

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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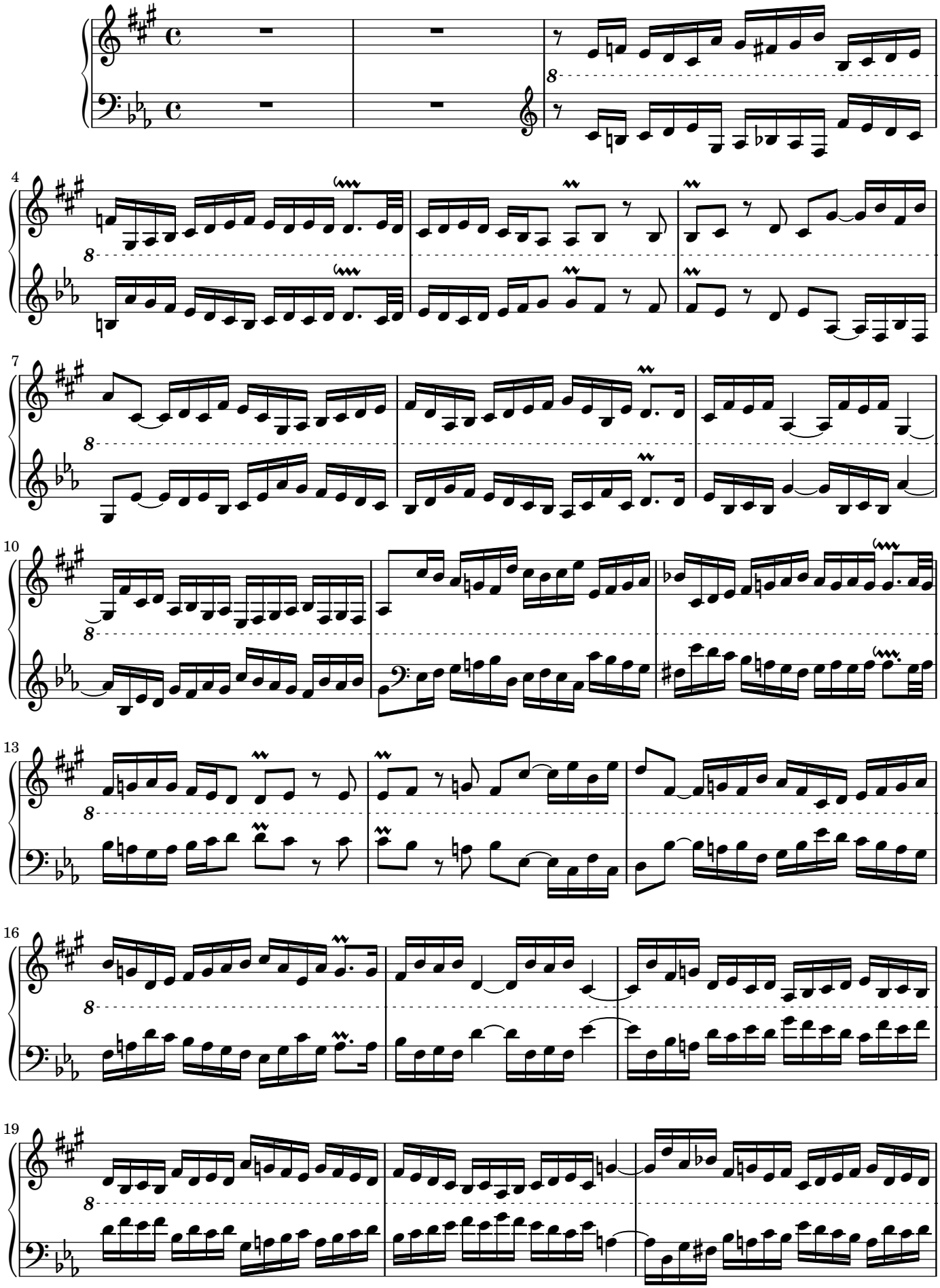
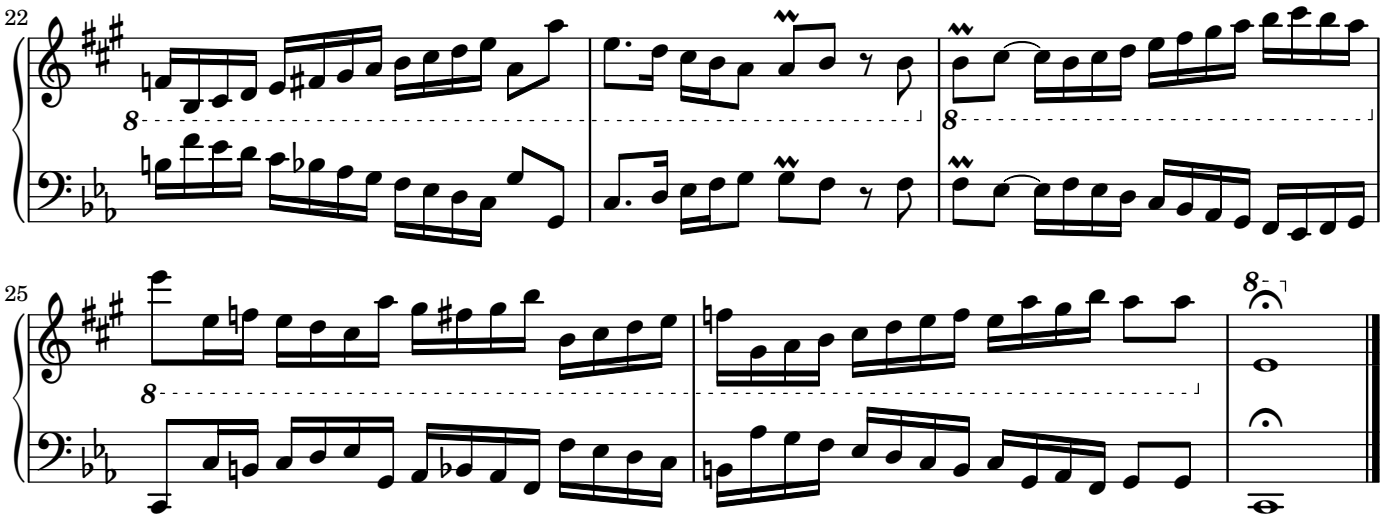
Invention 2, BWV 773

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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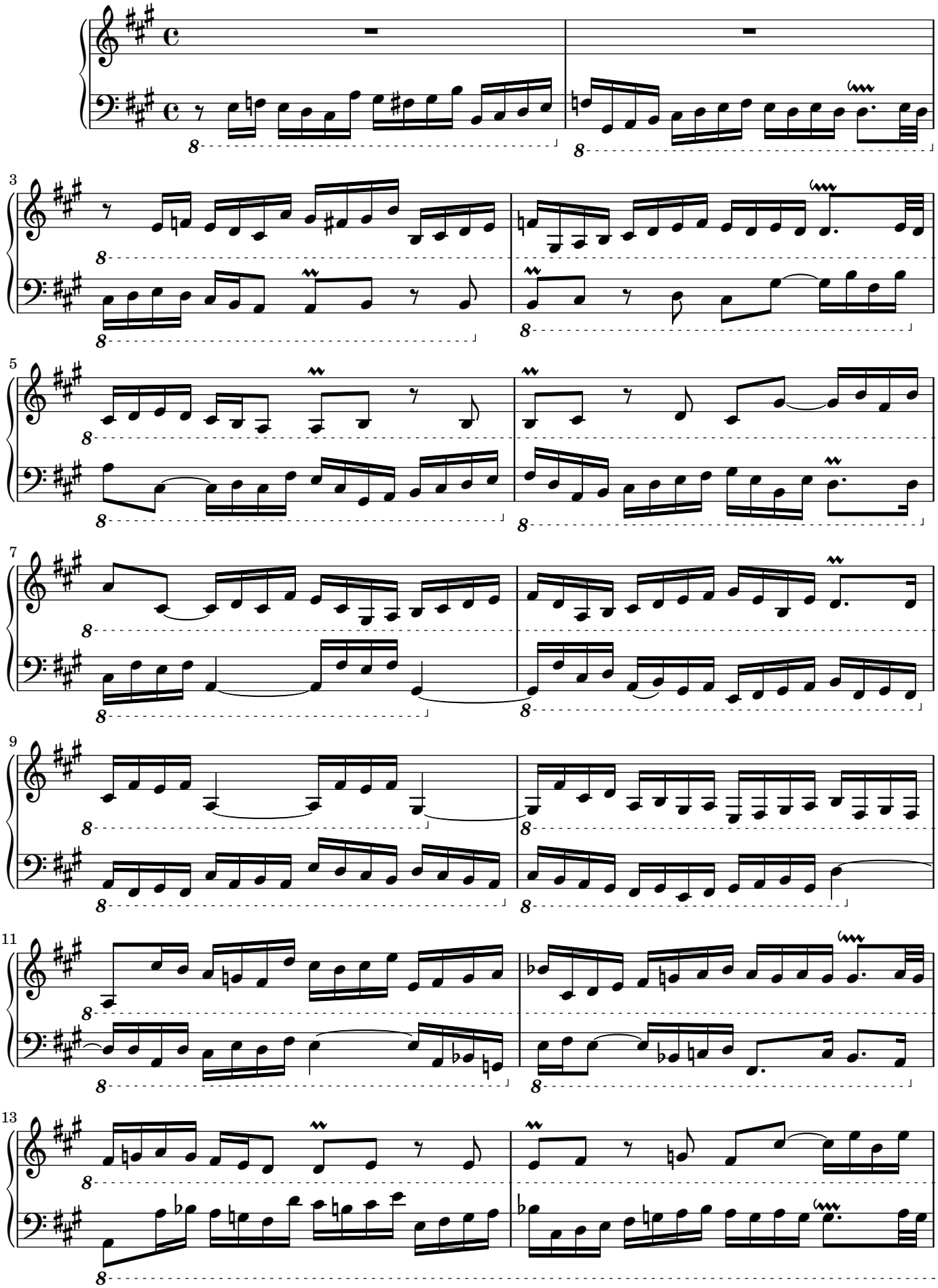
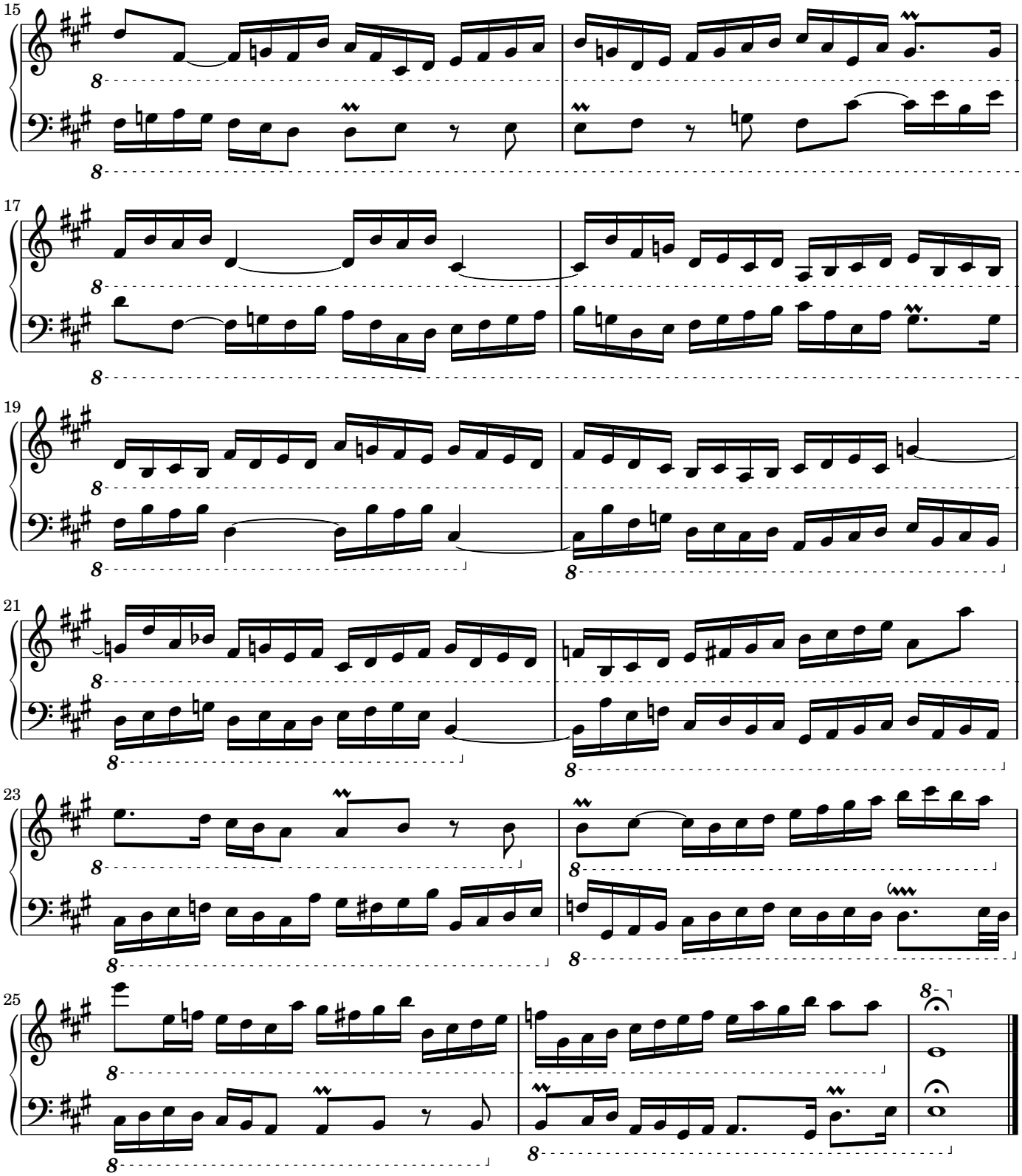
Invention 2, BWV 773

Benjamin Pritchard, after Johann Sebastian Bach

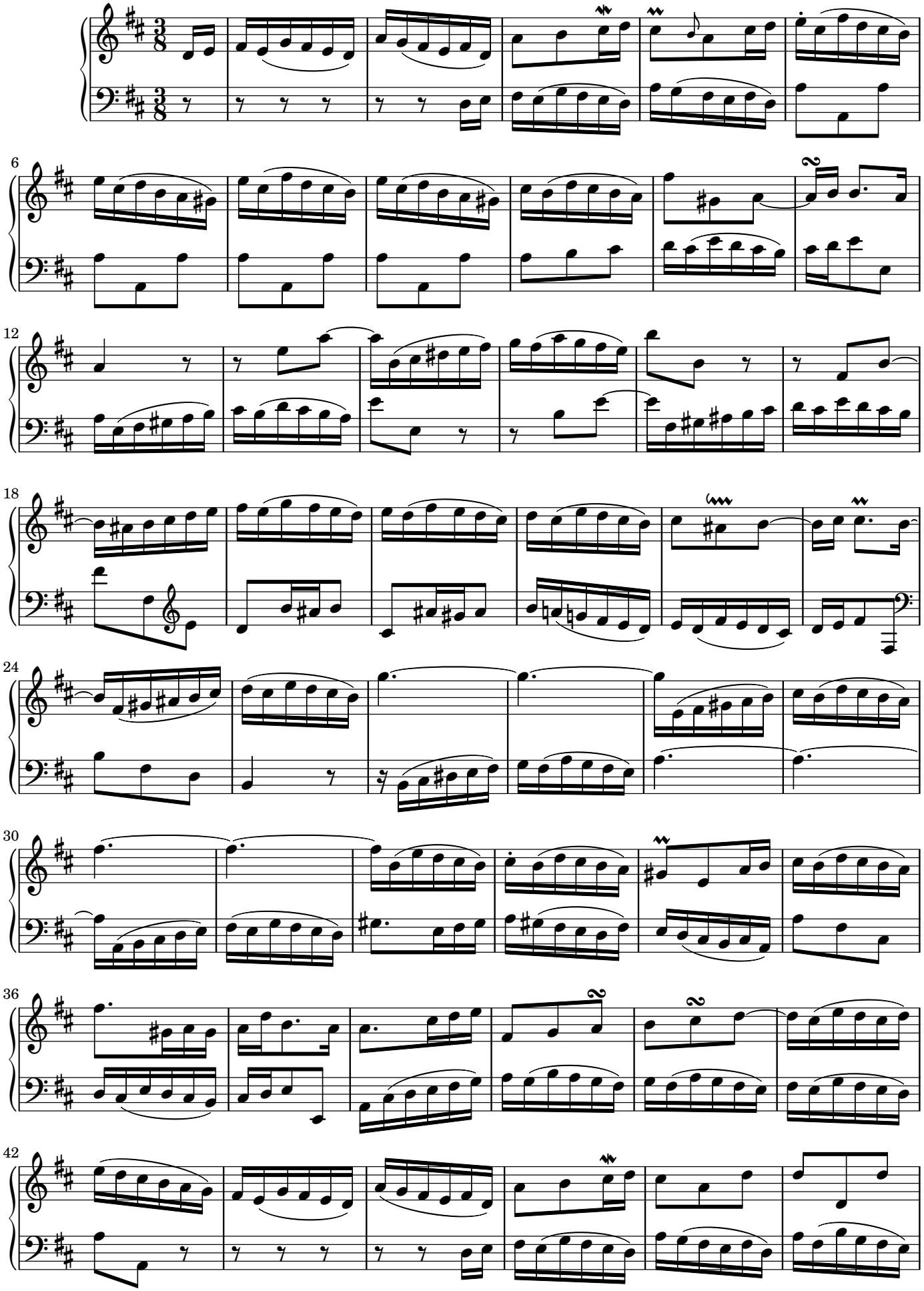
Mirror Image

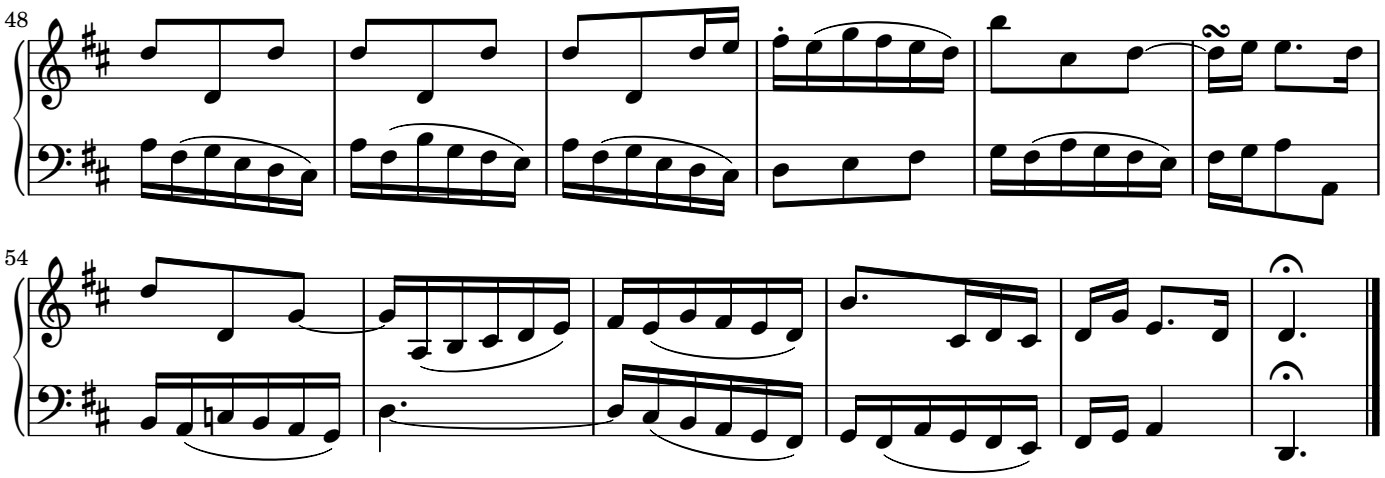




Invention 3, BWV 774

Johann Sebastian Bach

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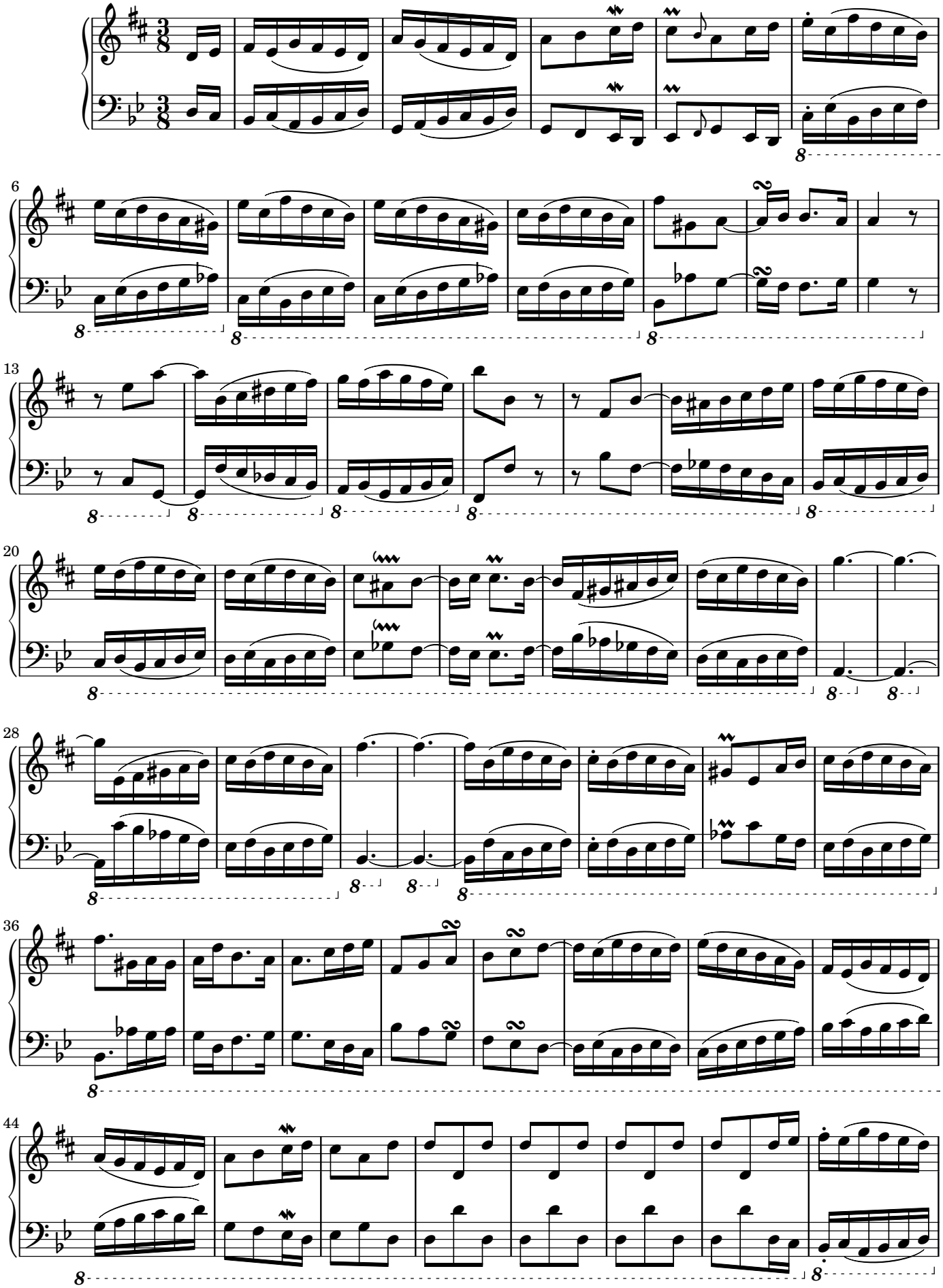
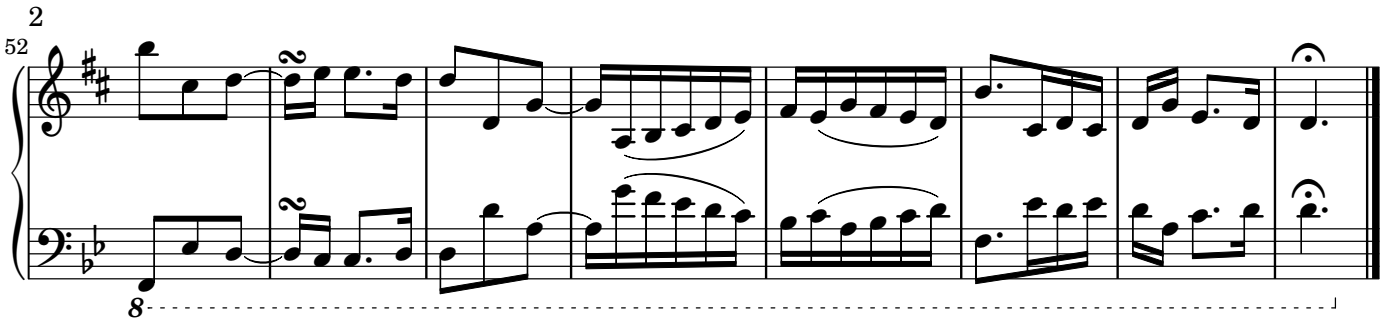
Invention 3, BWV 774

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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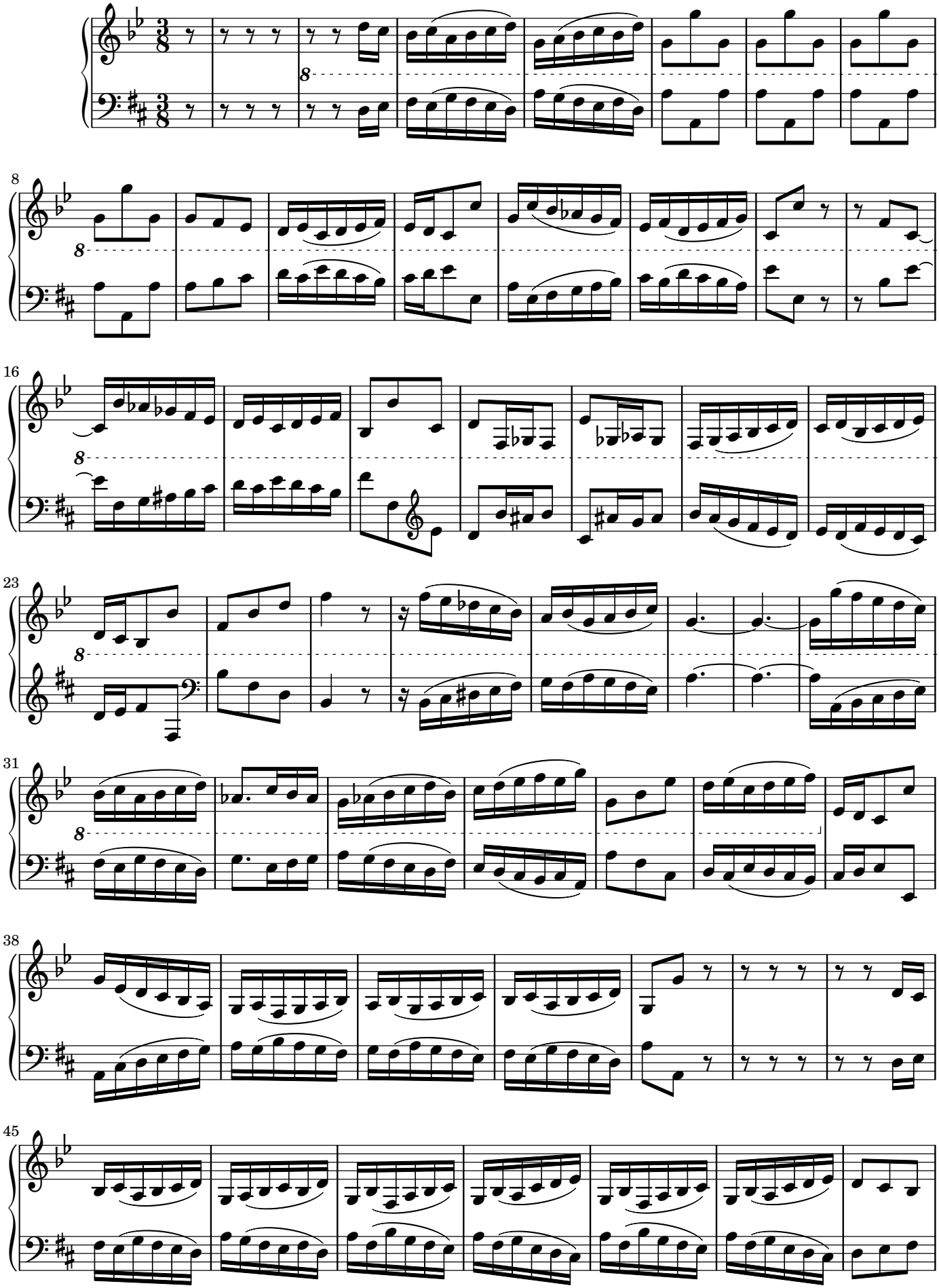
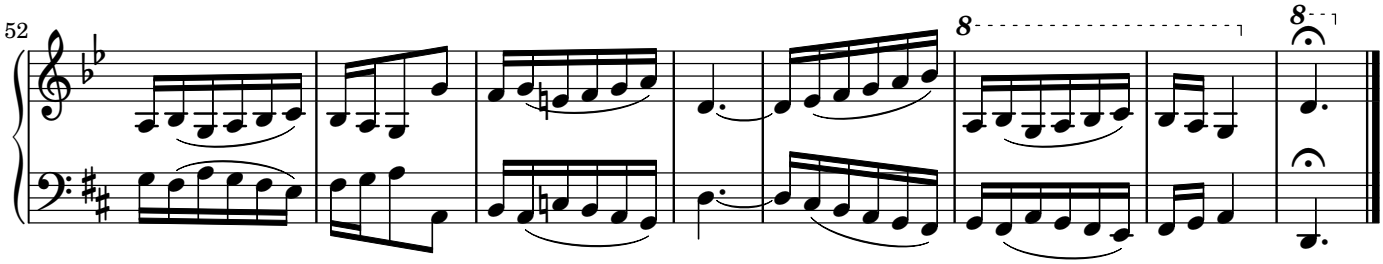
Invention 3, BWV 774

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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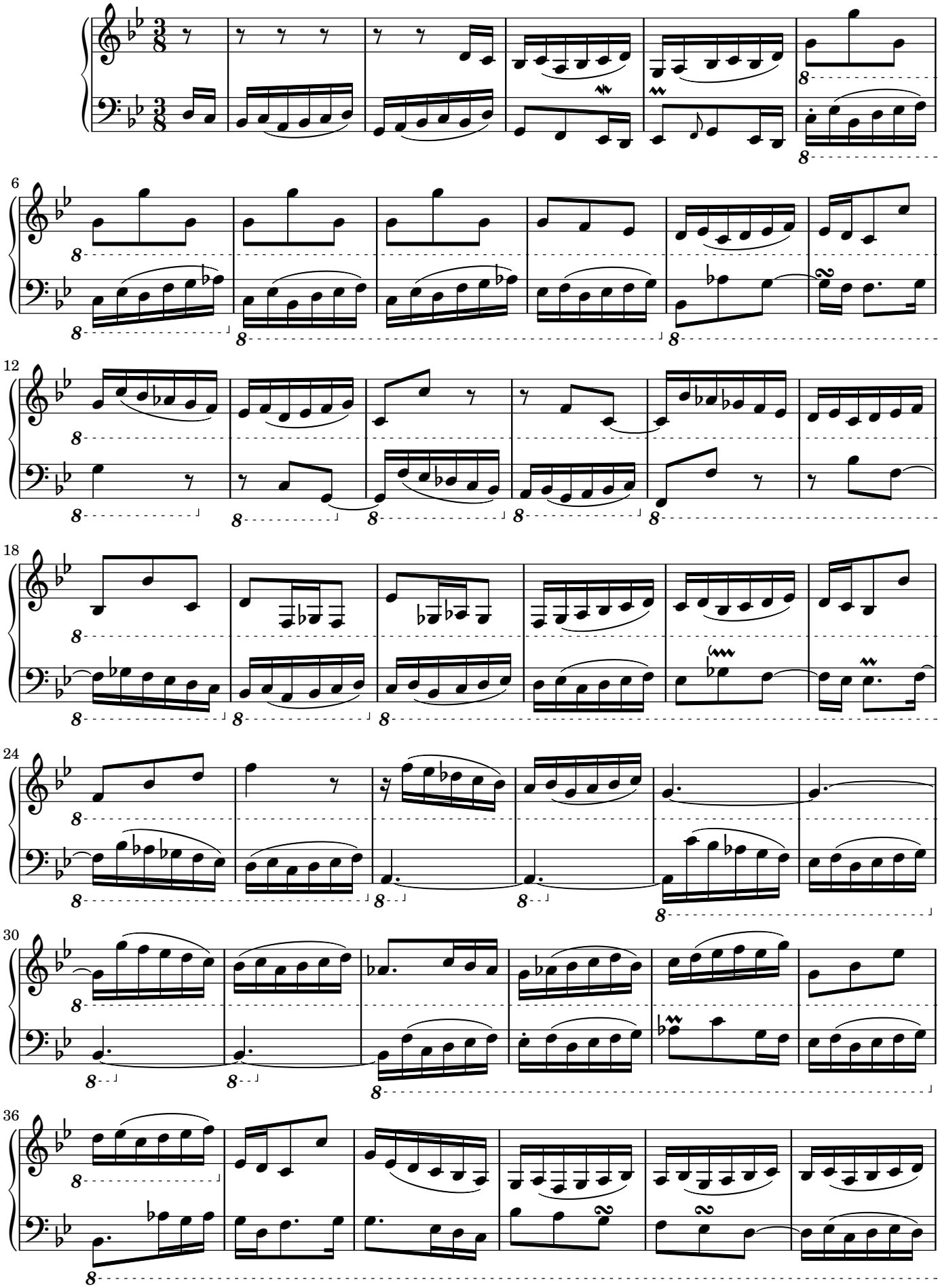
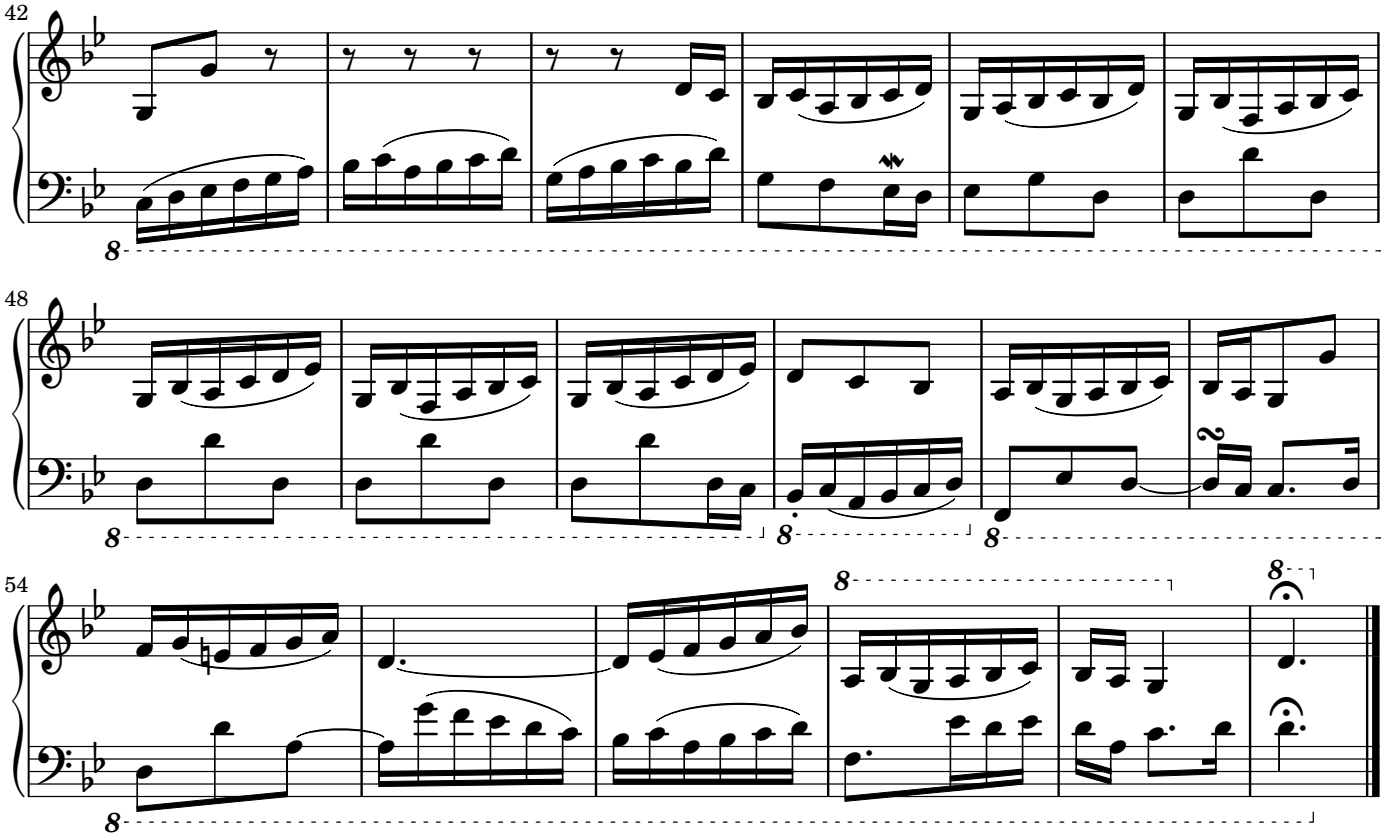
Invention 3, BWV 774

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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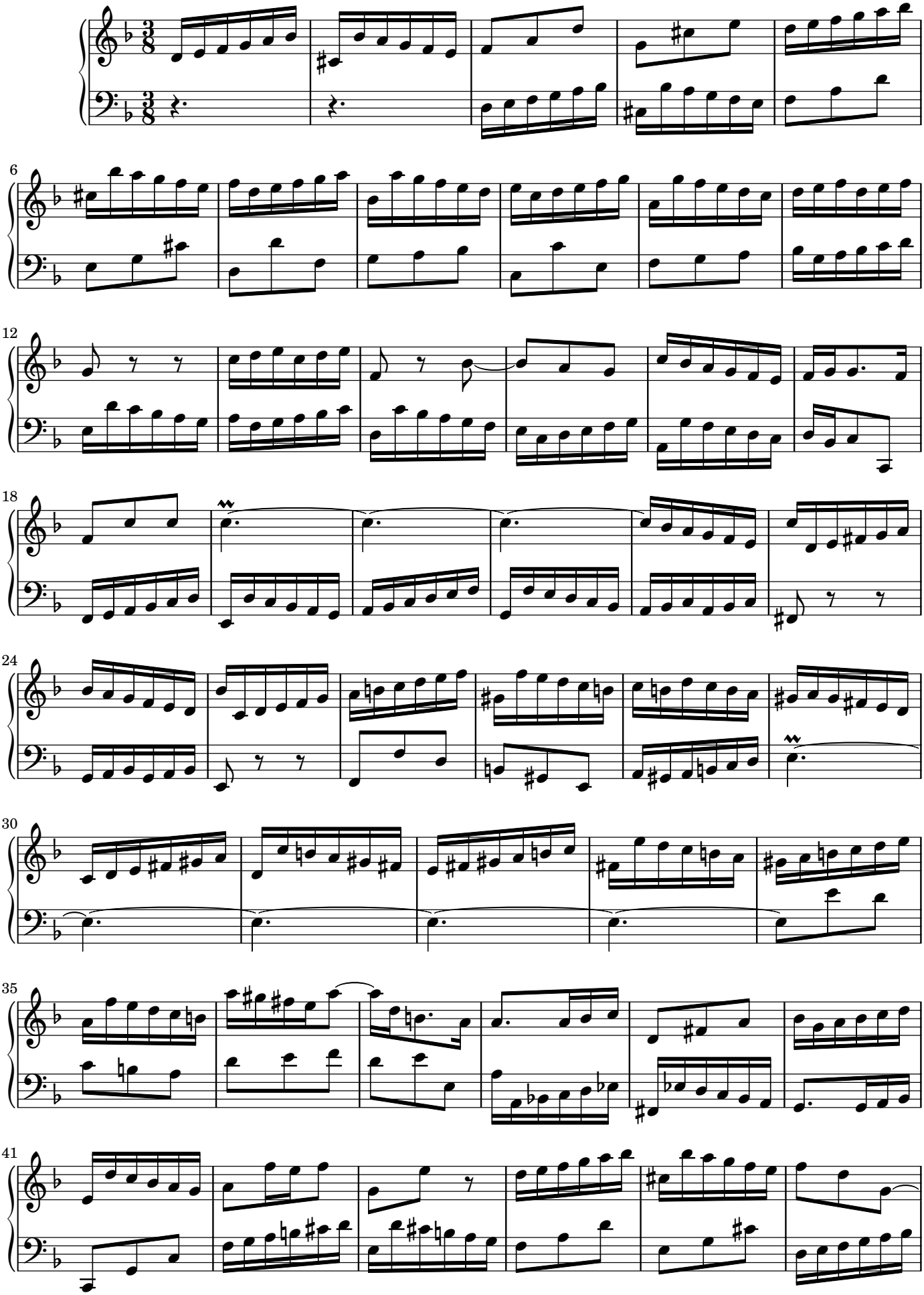
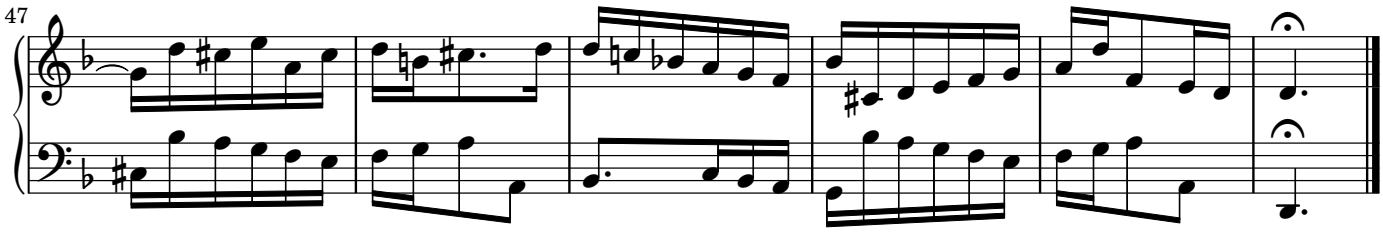
Invention 4, BWV 775

Johann Sebastian Bach

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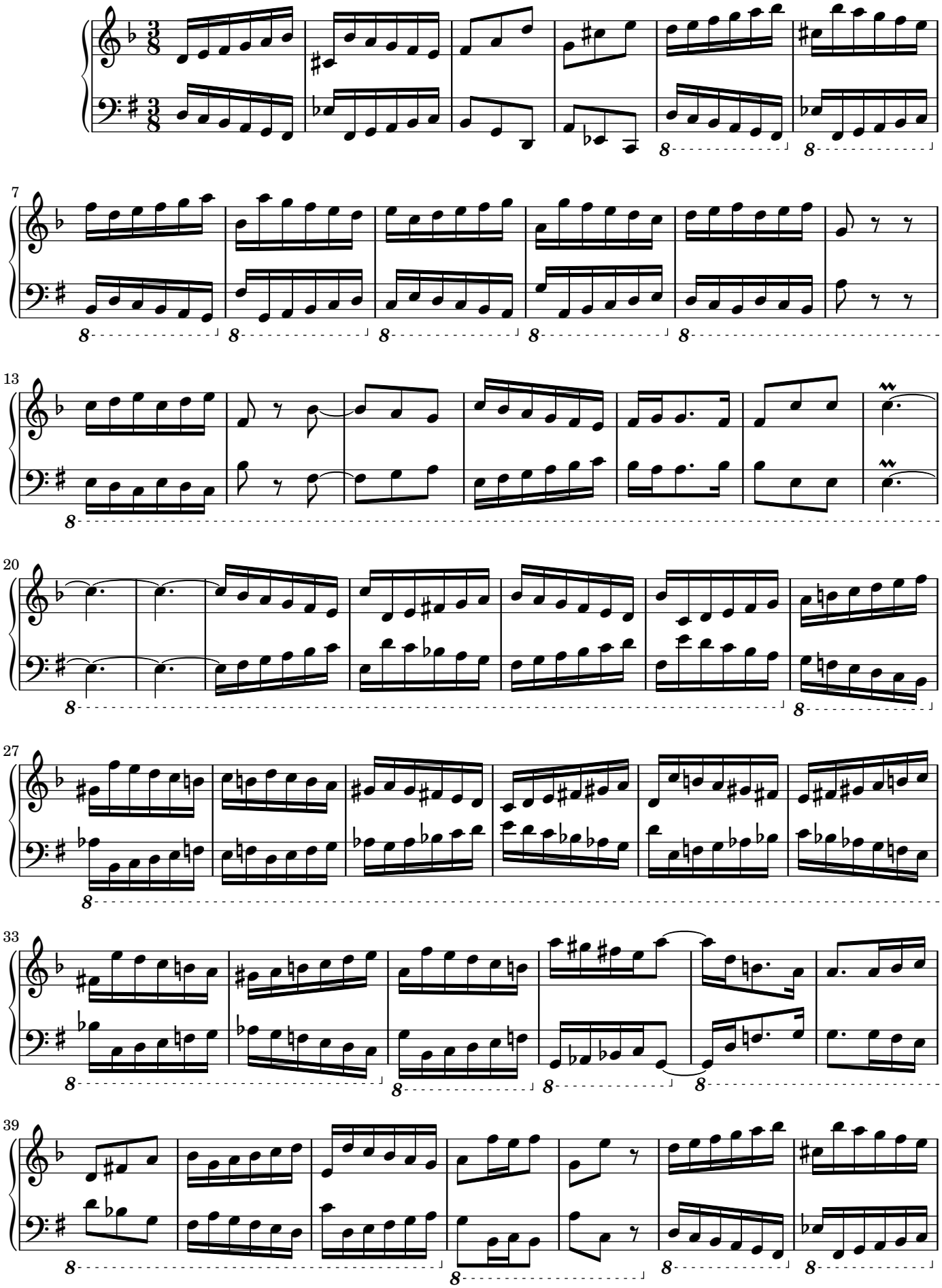
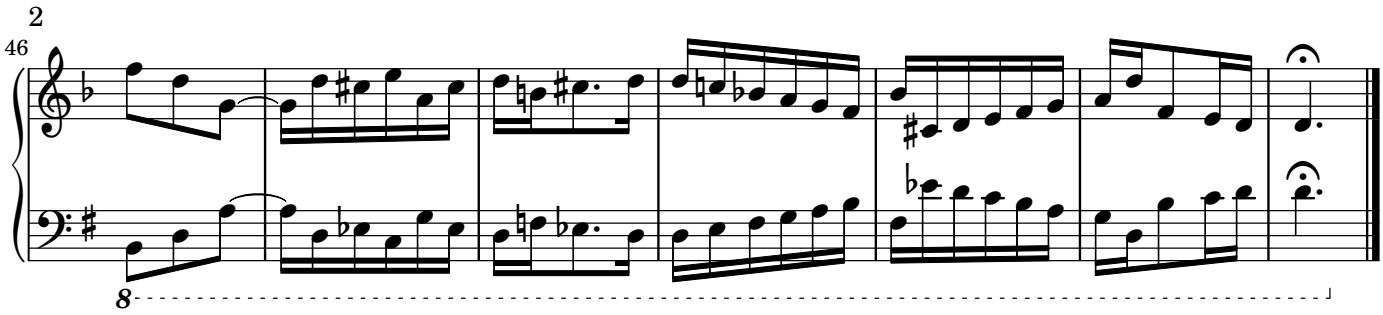
Invention 4, BWV 775

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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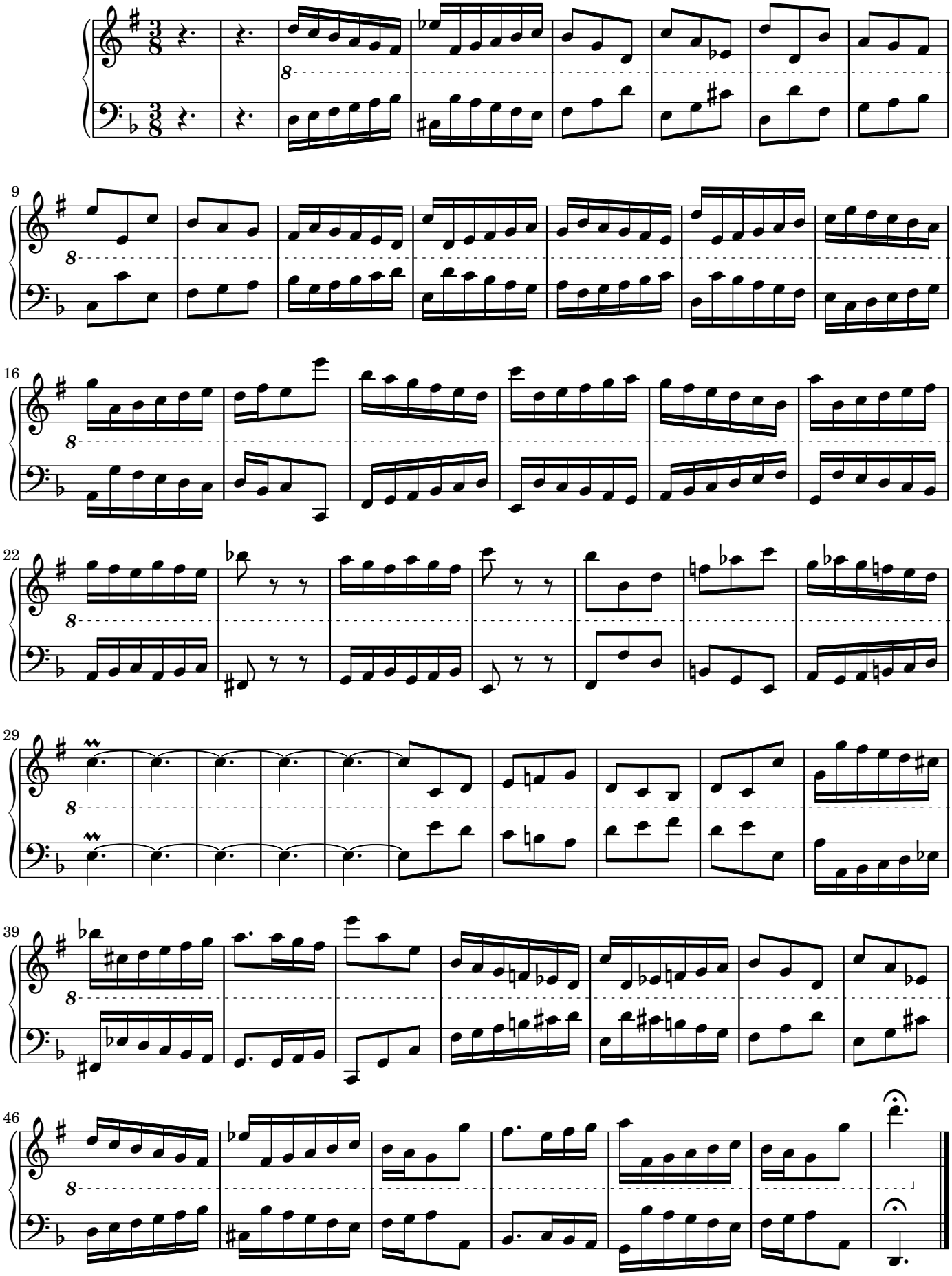
Invention 4, BWV 775

Benjamin Pritchard, after Johann Sebastian Bach

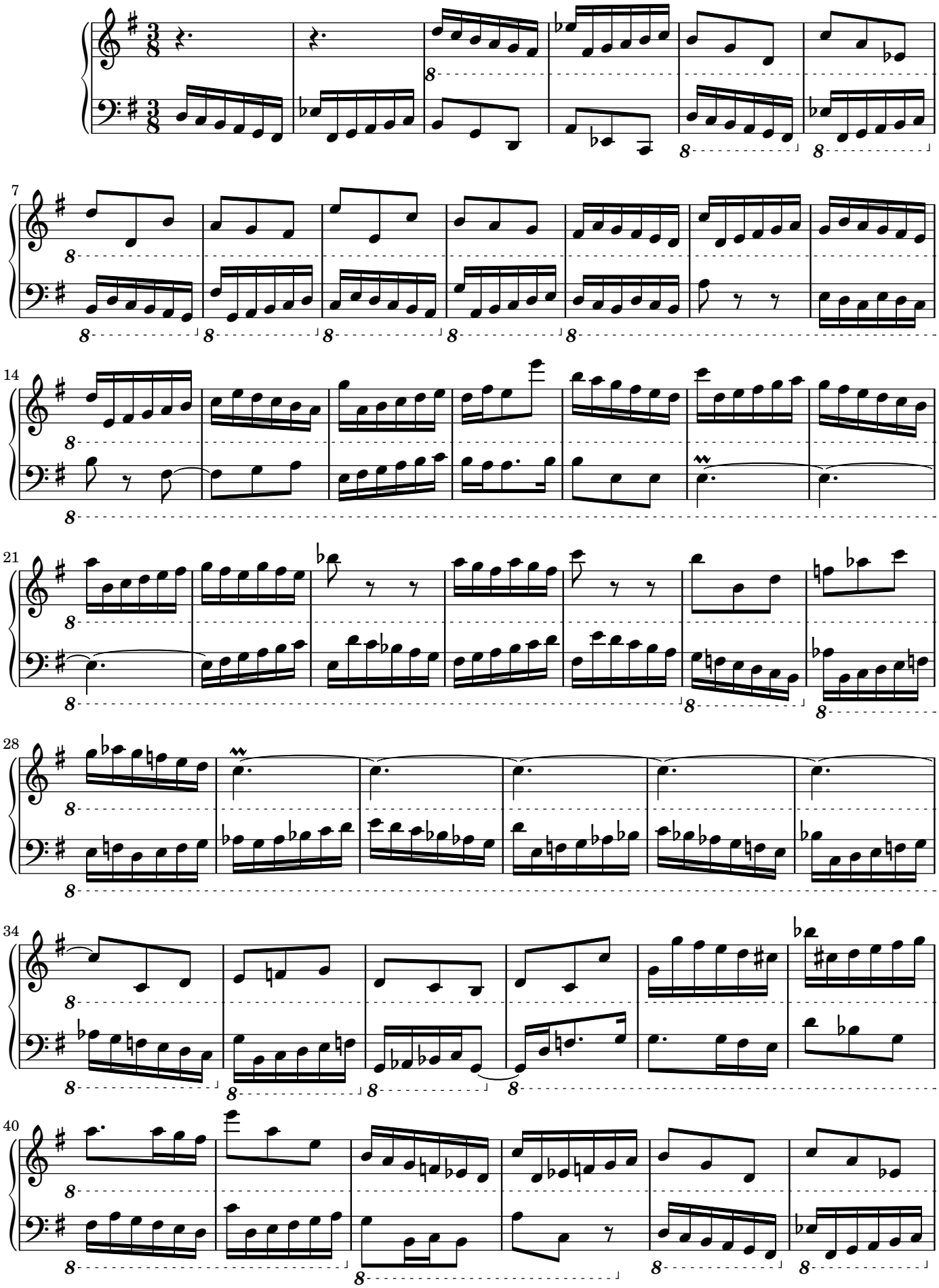
Right Hand Descending

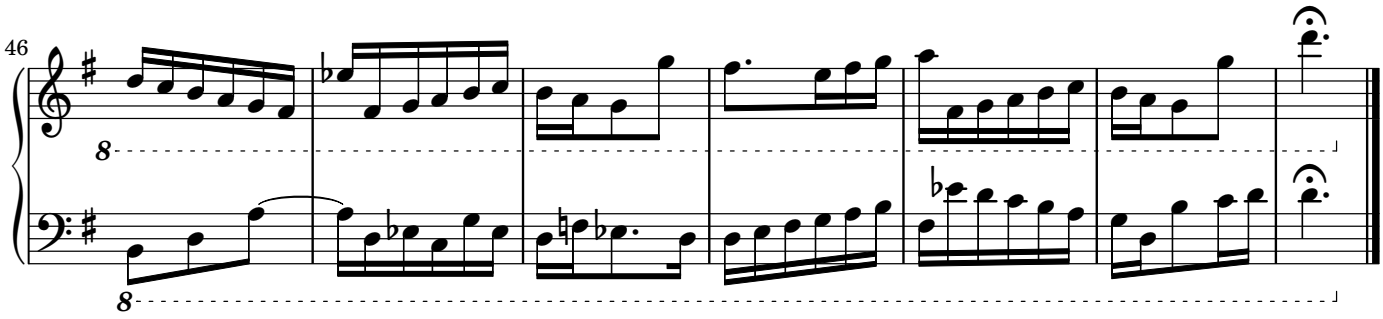


Invention 4, BWV 775

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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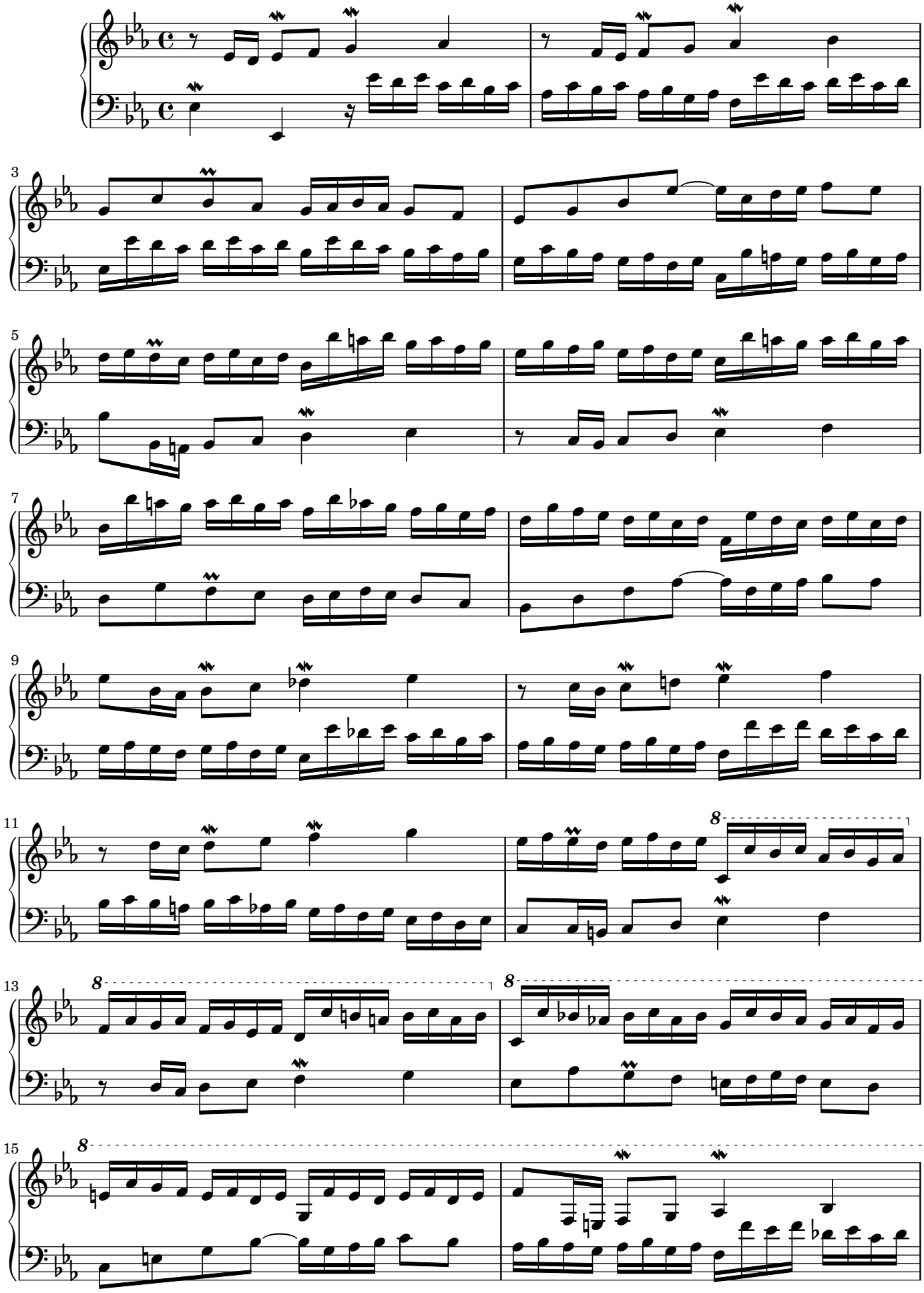
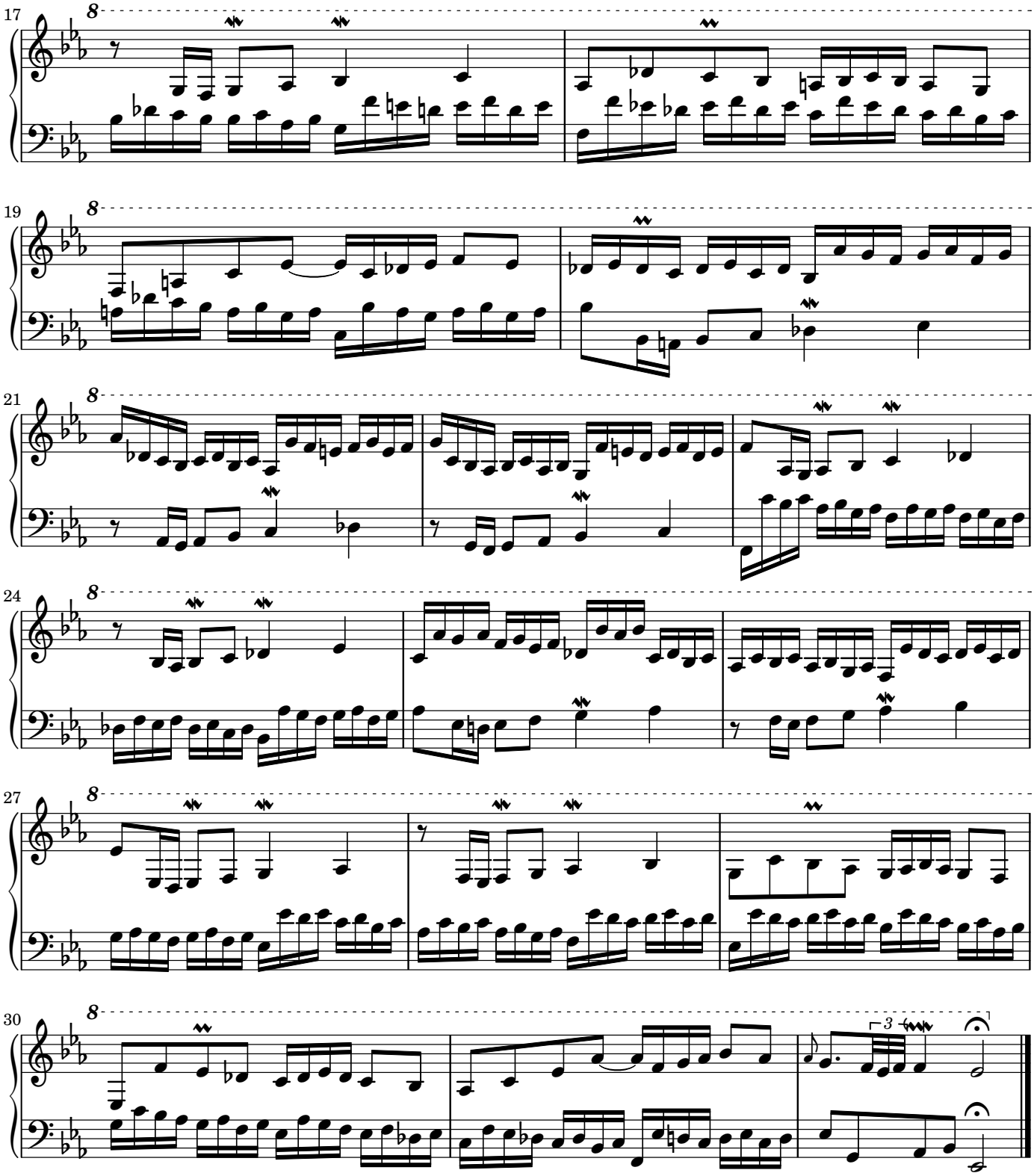
Invention 5, BWV 776

Johann Sebastian Bach

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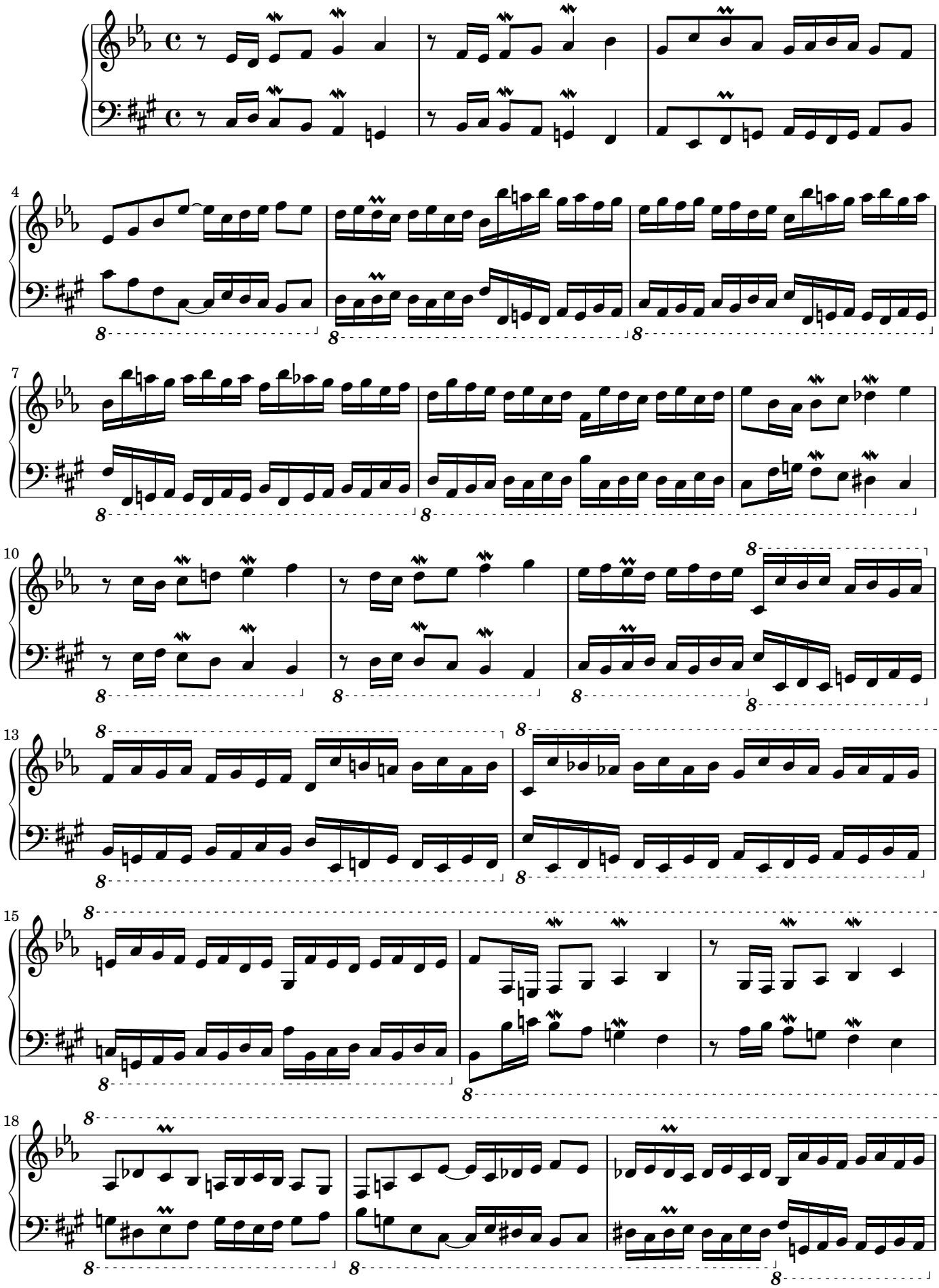
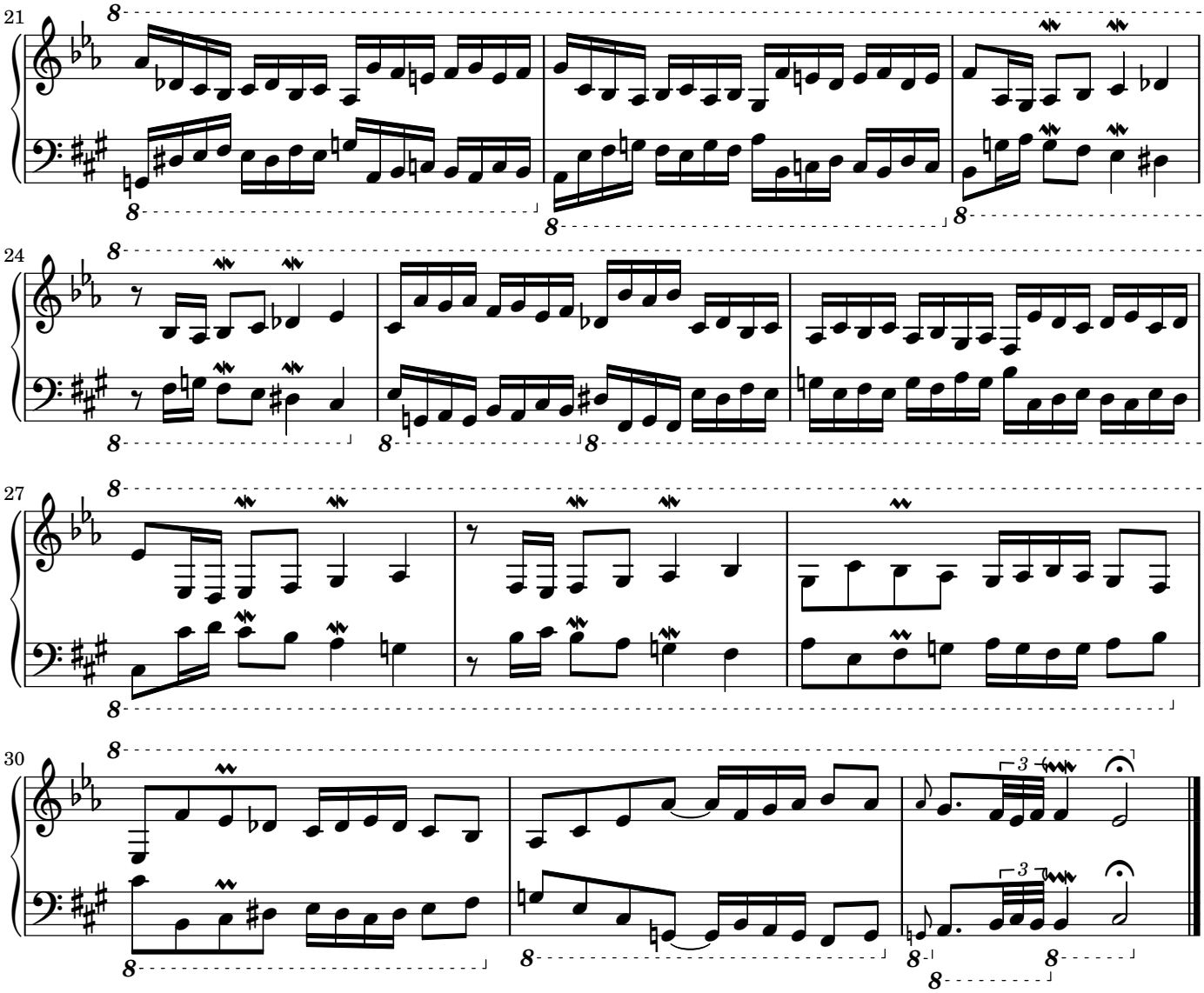
Invention 5, BWV 776

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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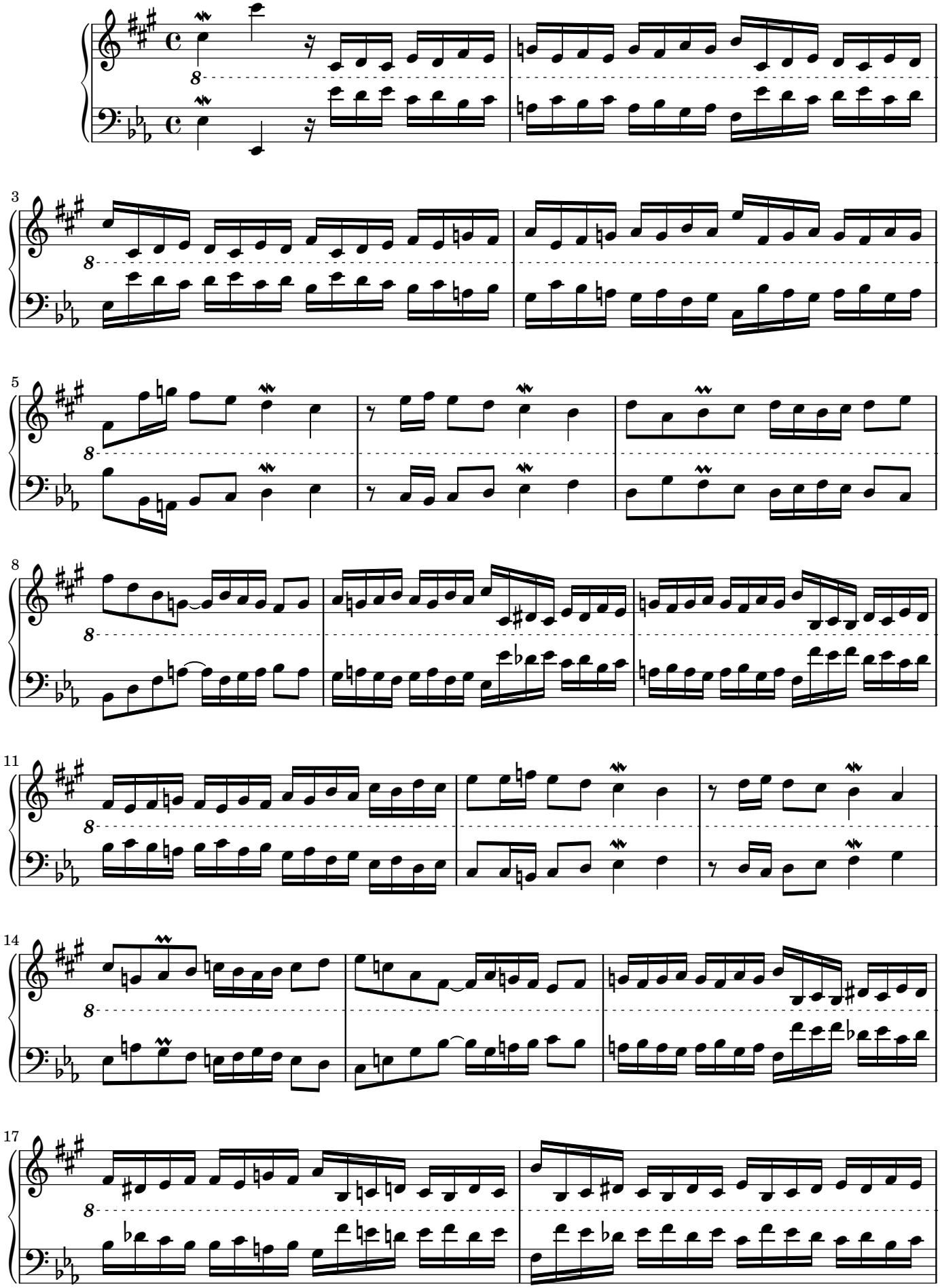
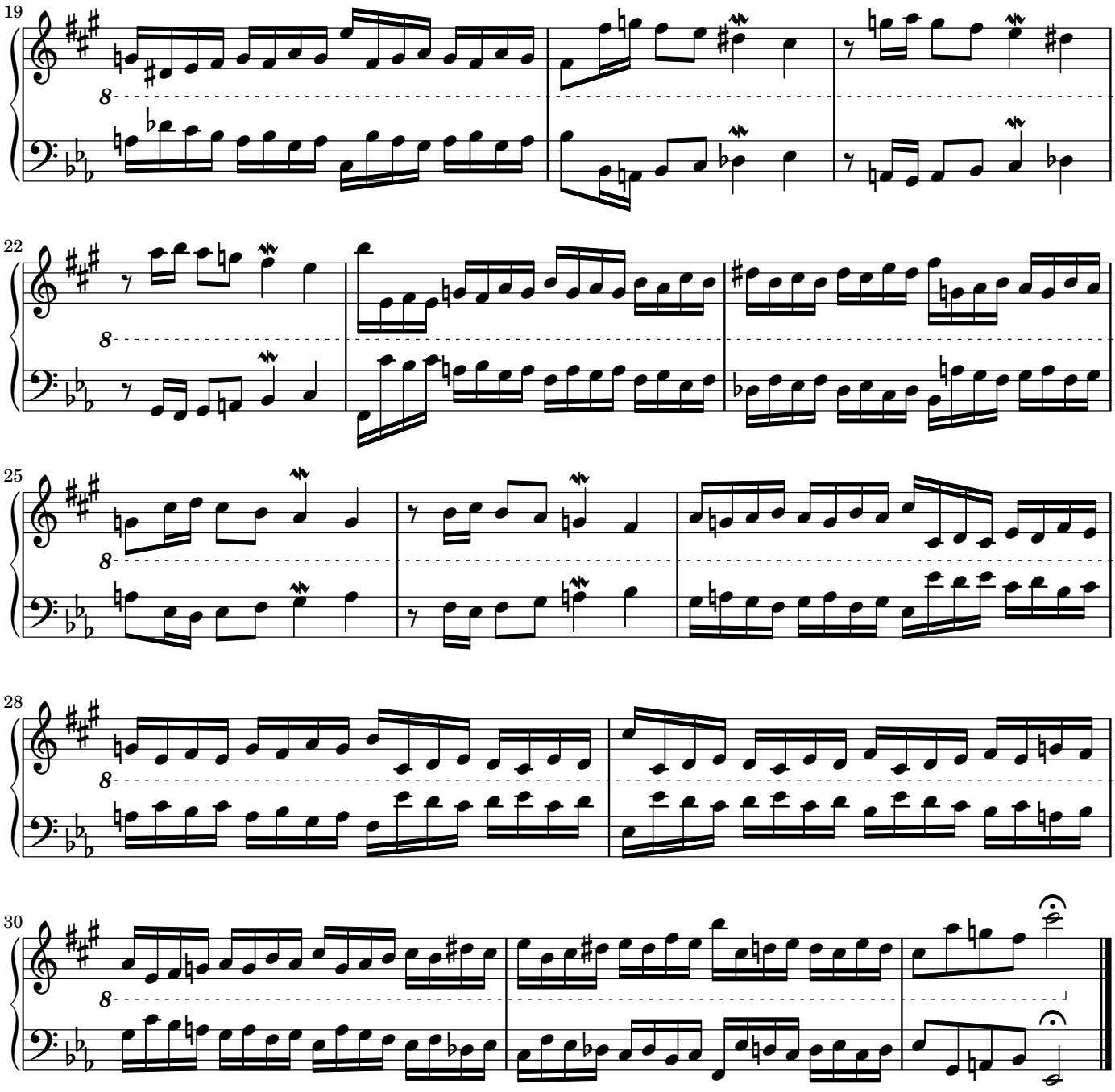
Invention 5, BWV 776

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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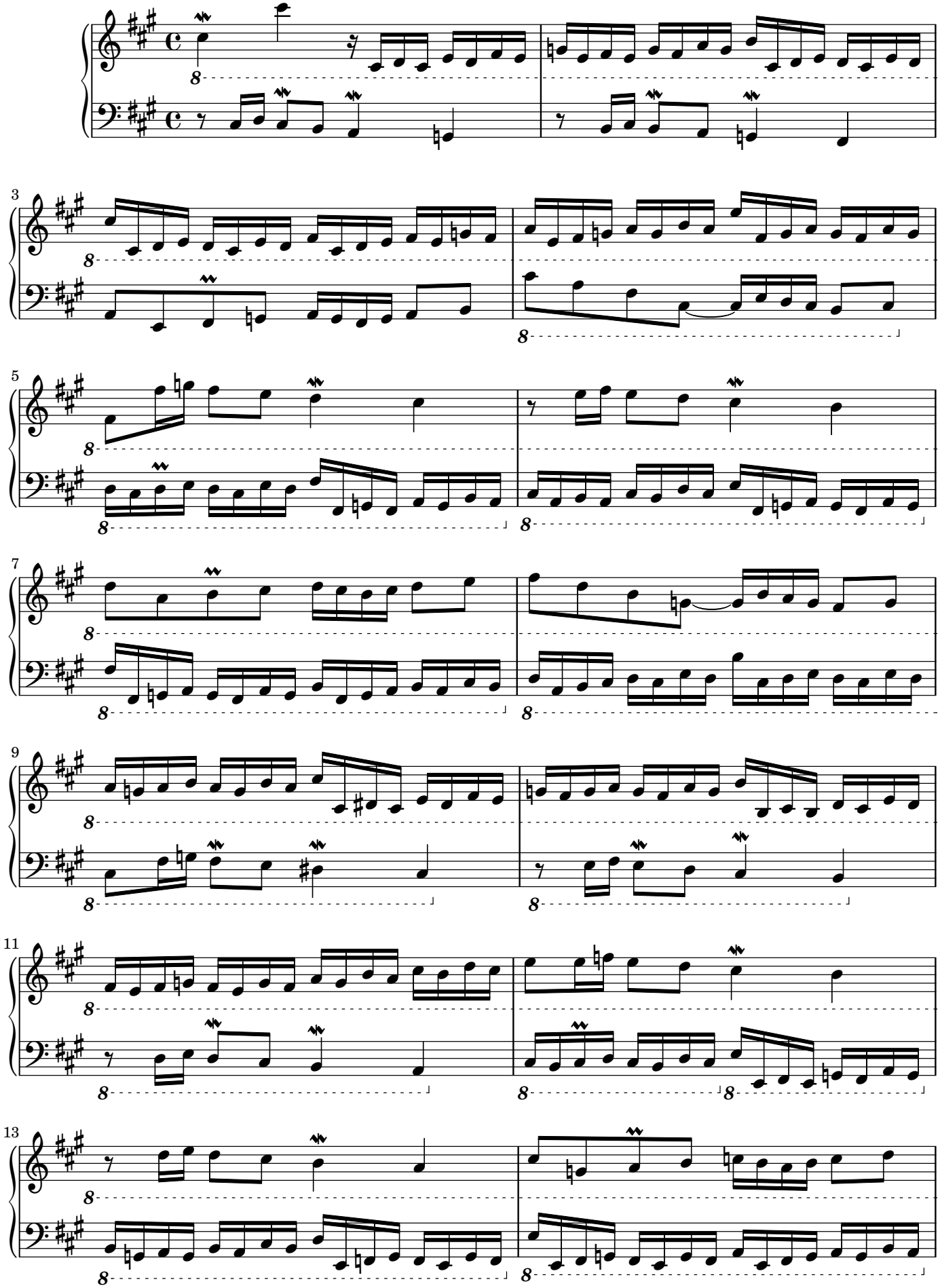
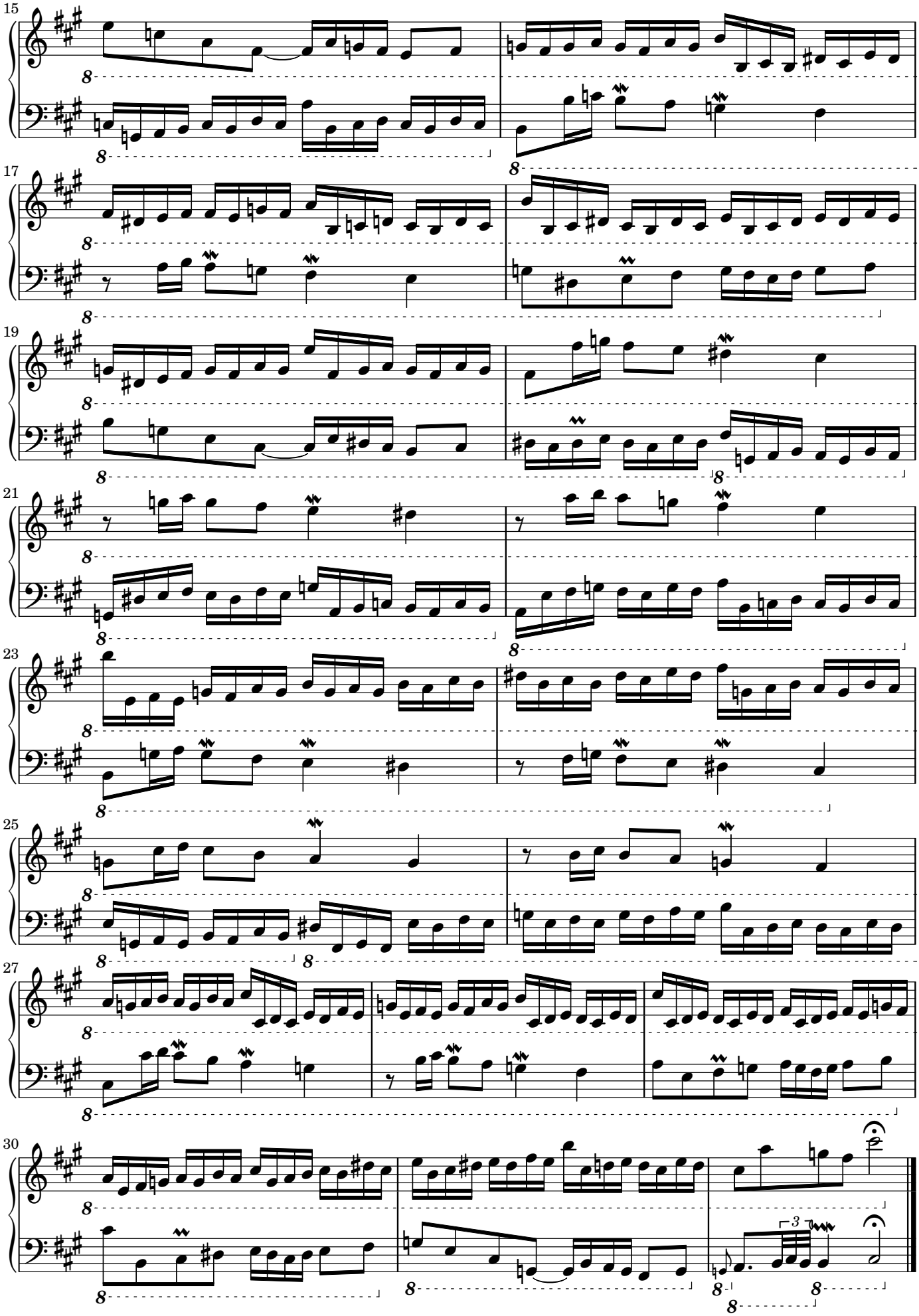
Invention 5, BWV 776

Benjamin Pritchard, after Johann Sebastian Bach

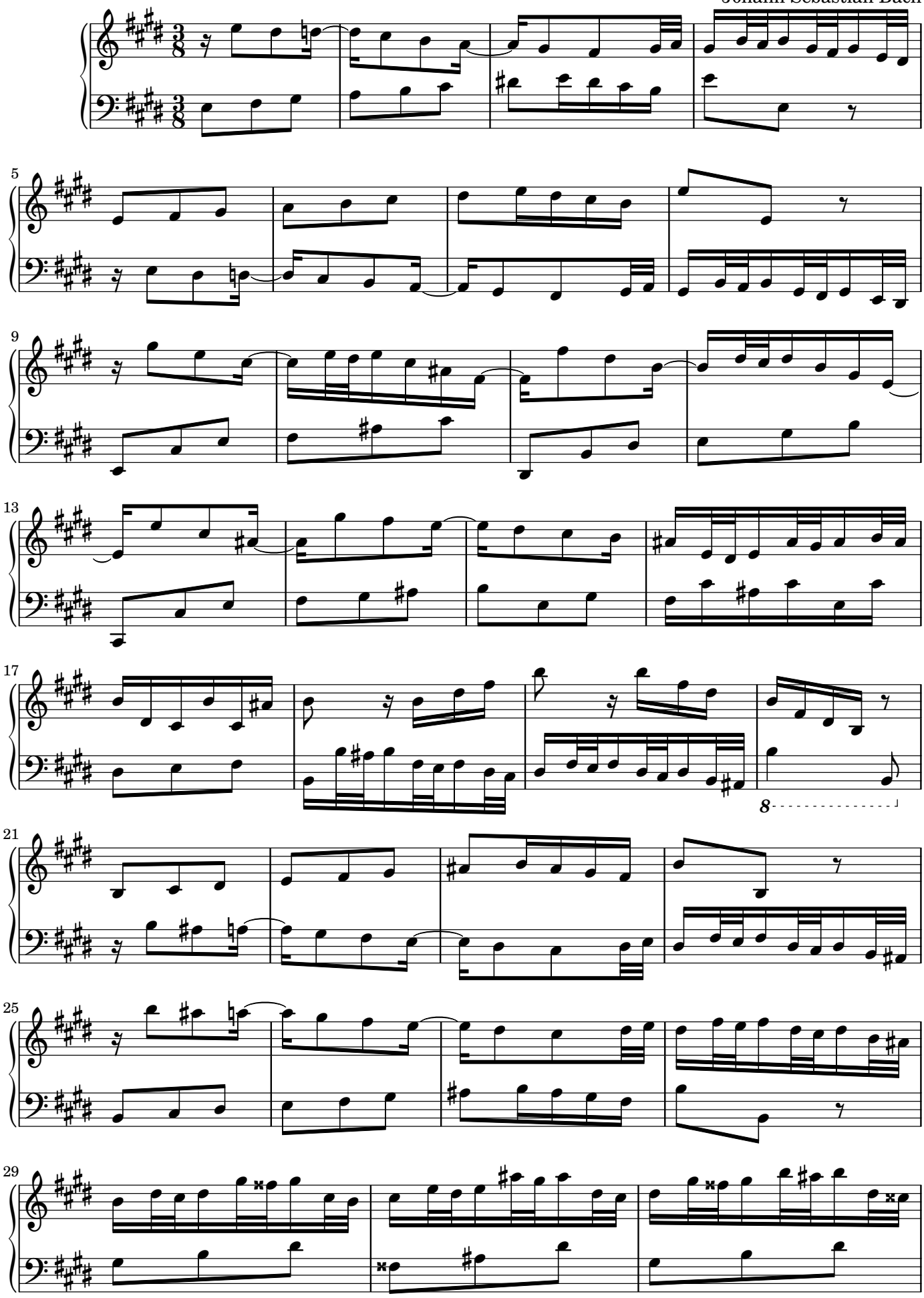
Mirror Image

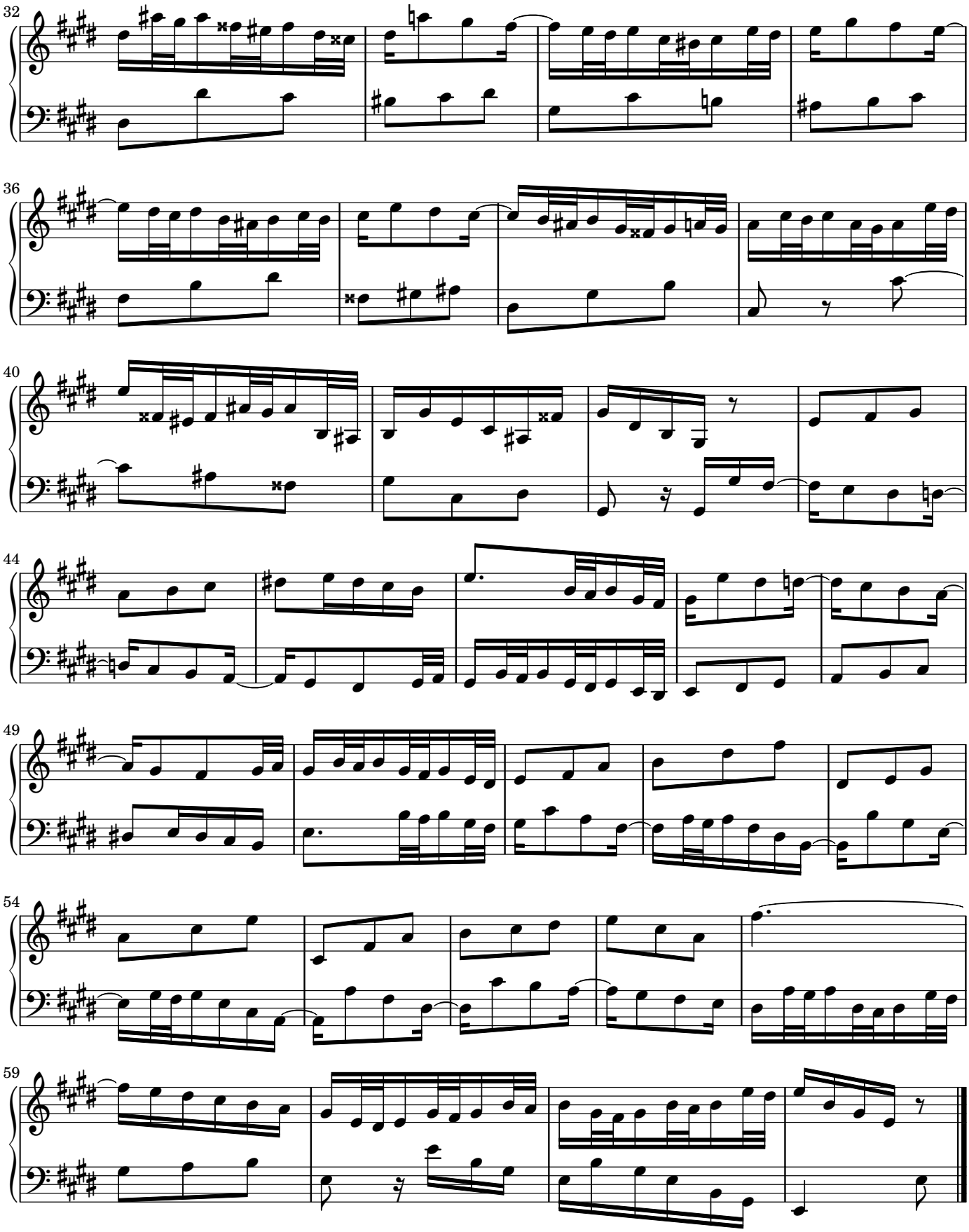




Invention 6, BWV 777

Johann Sebastian Bach




32
36
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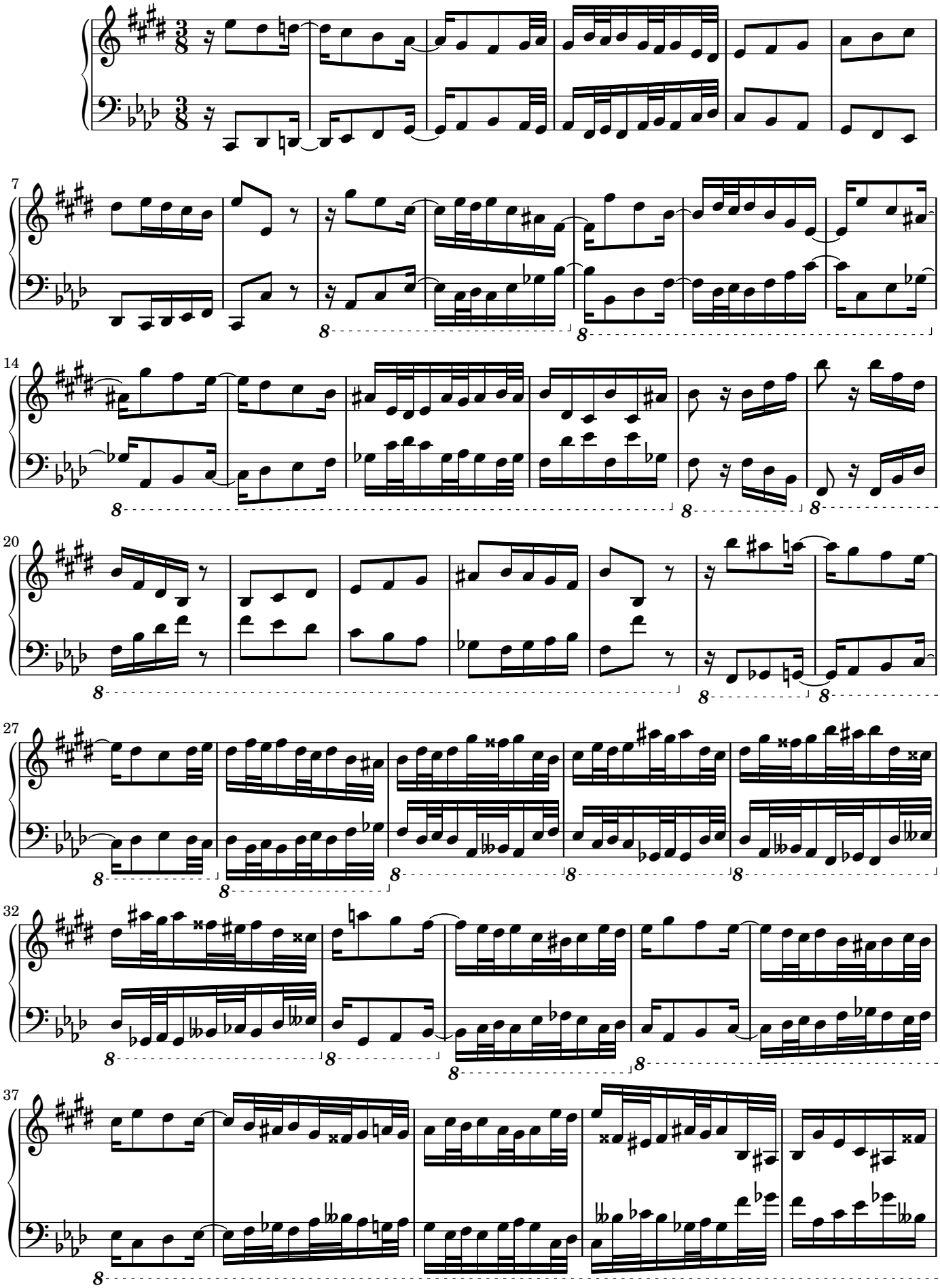
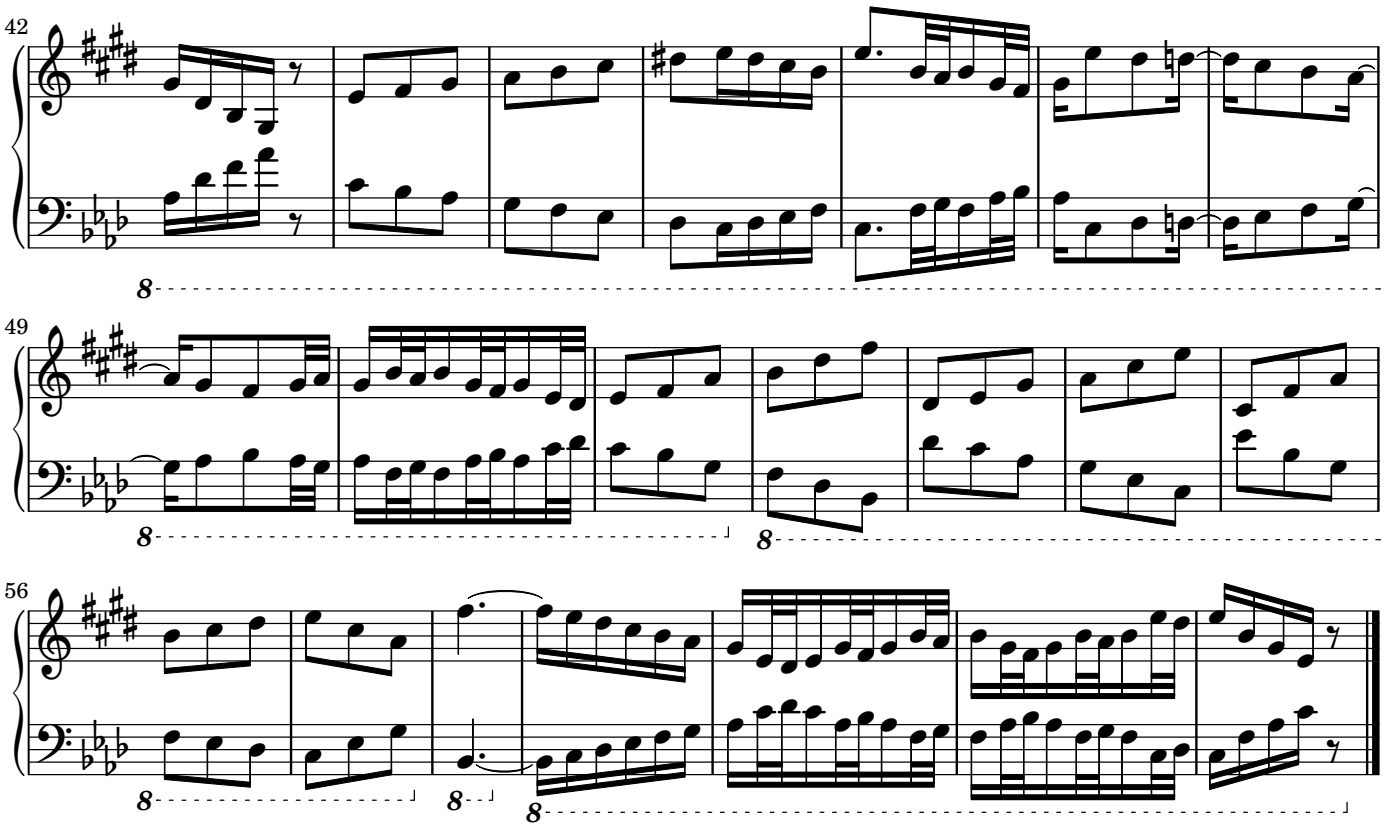
44
49
54
59

Invention 6, BWV 777

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending




42
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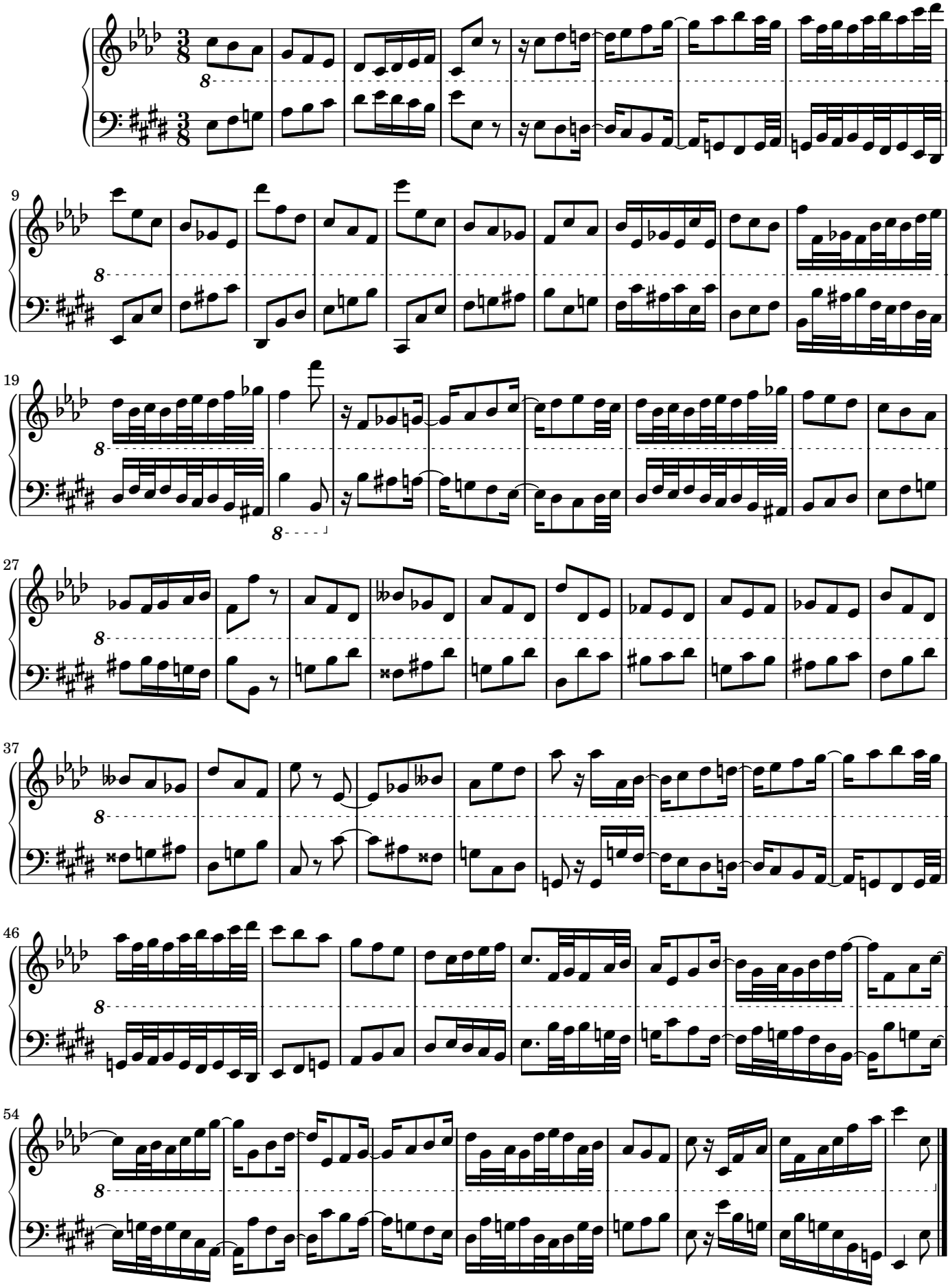
Invention 6, BWV 777

Benjamin Pritchard, after Johann Sebastian Bach

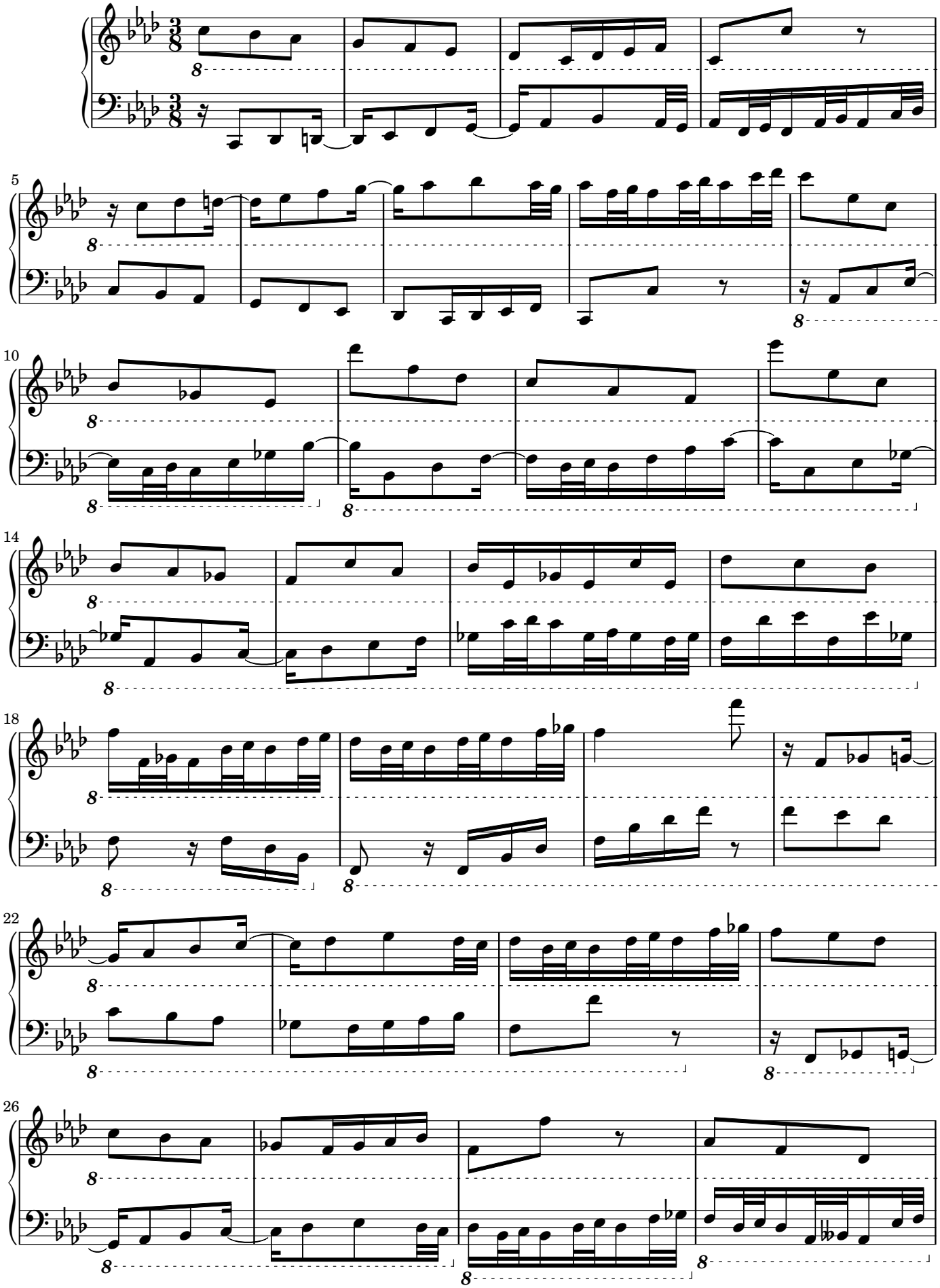
Right Hand Descending

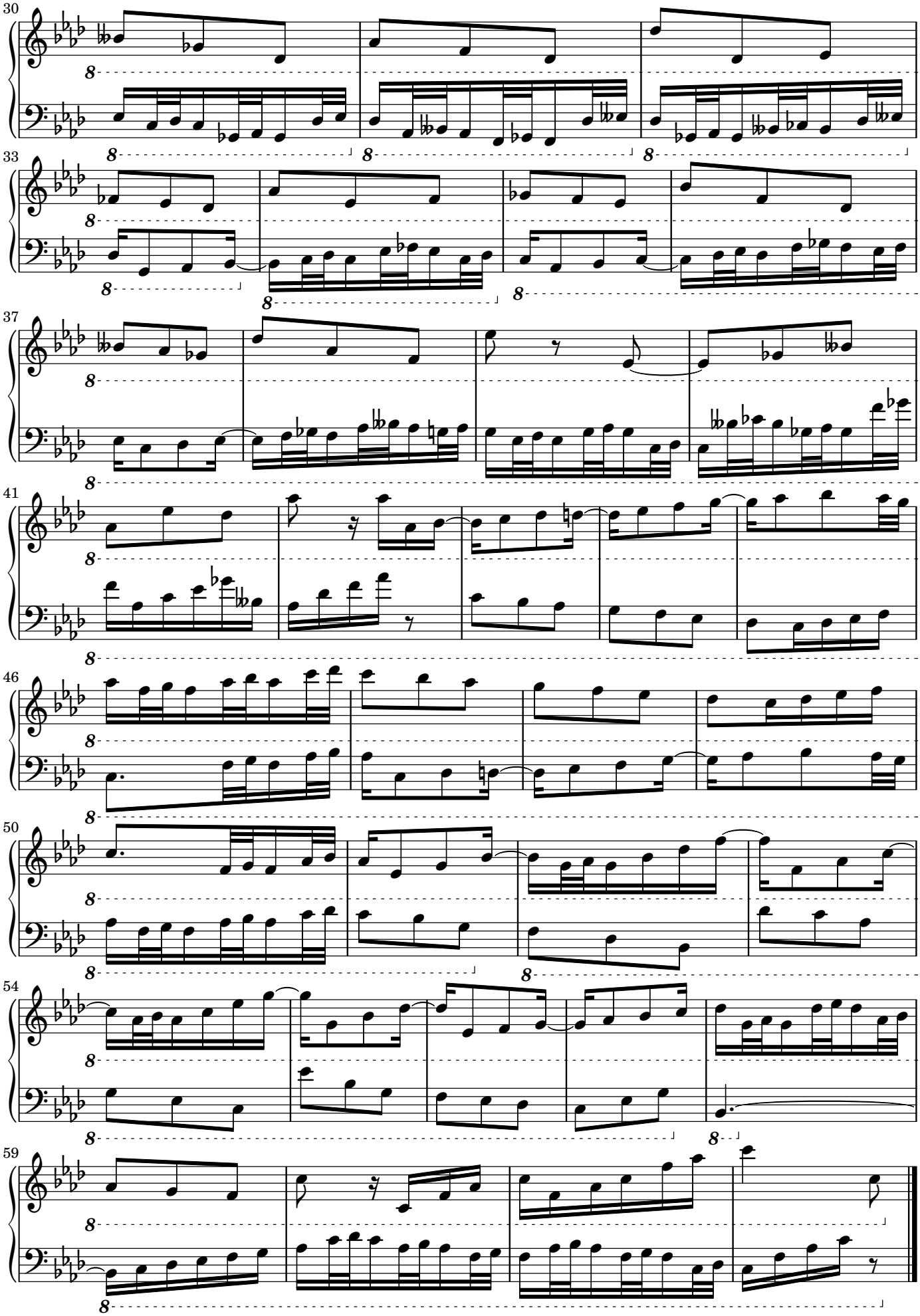


Invention 6, BWV 777

Benjamin Pritchard, after Johann Sebastian Bach

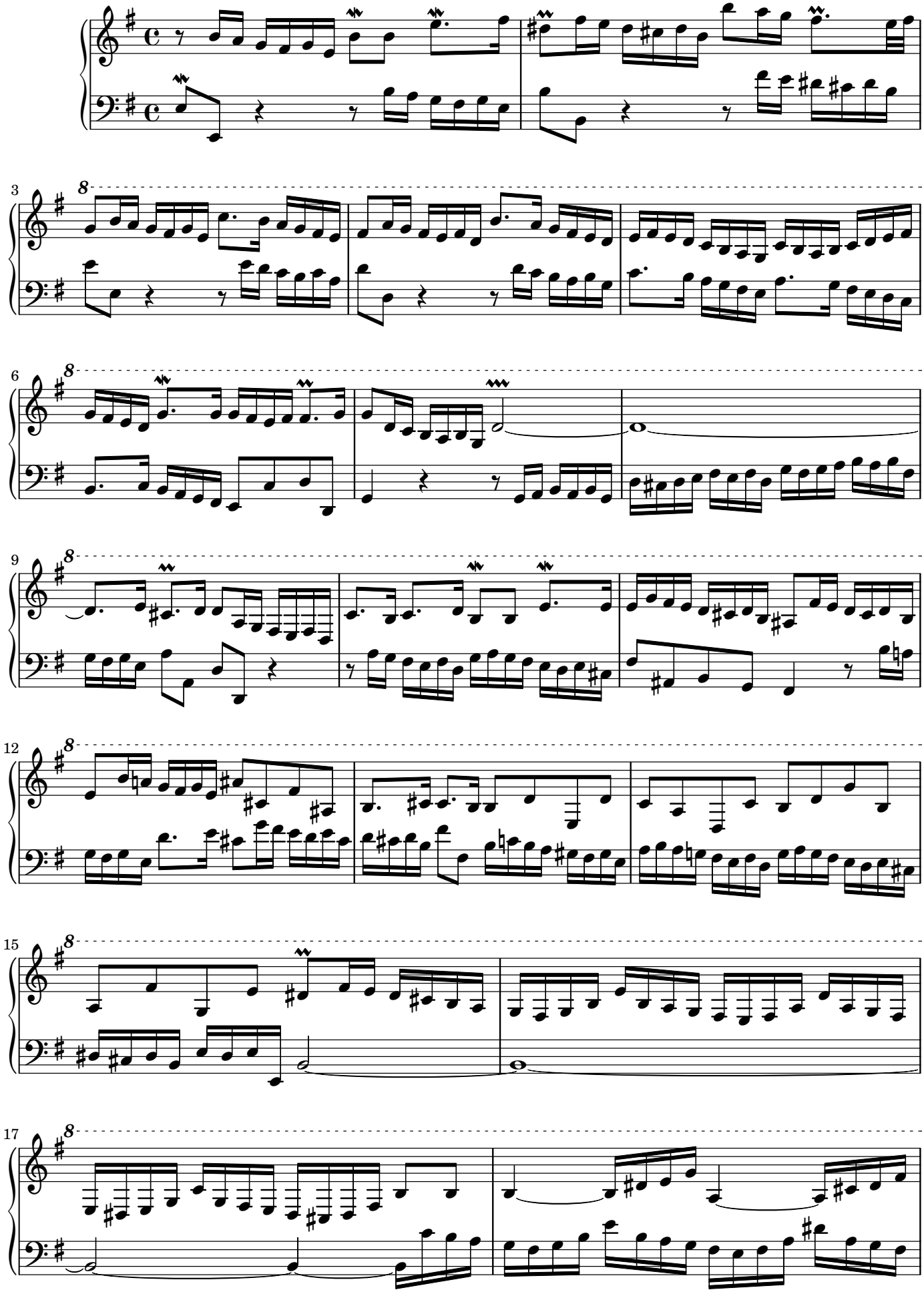
Mirror Image

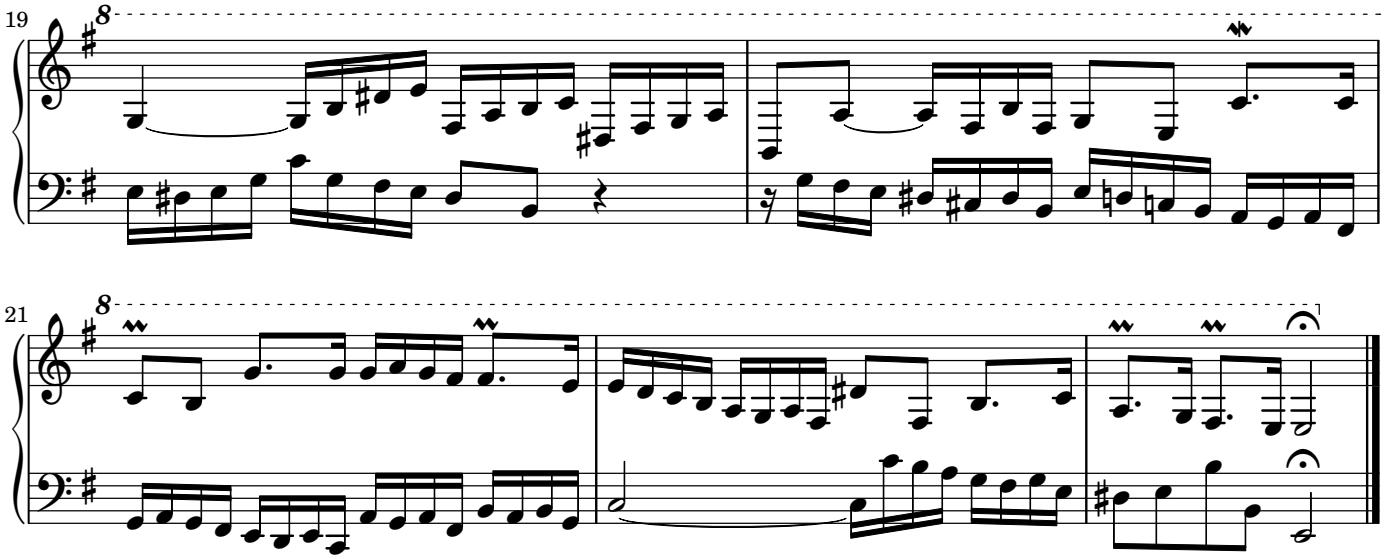




Invention 7, BWV 778

Johann Sebastian Bach

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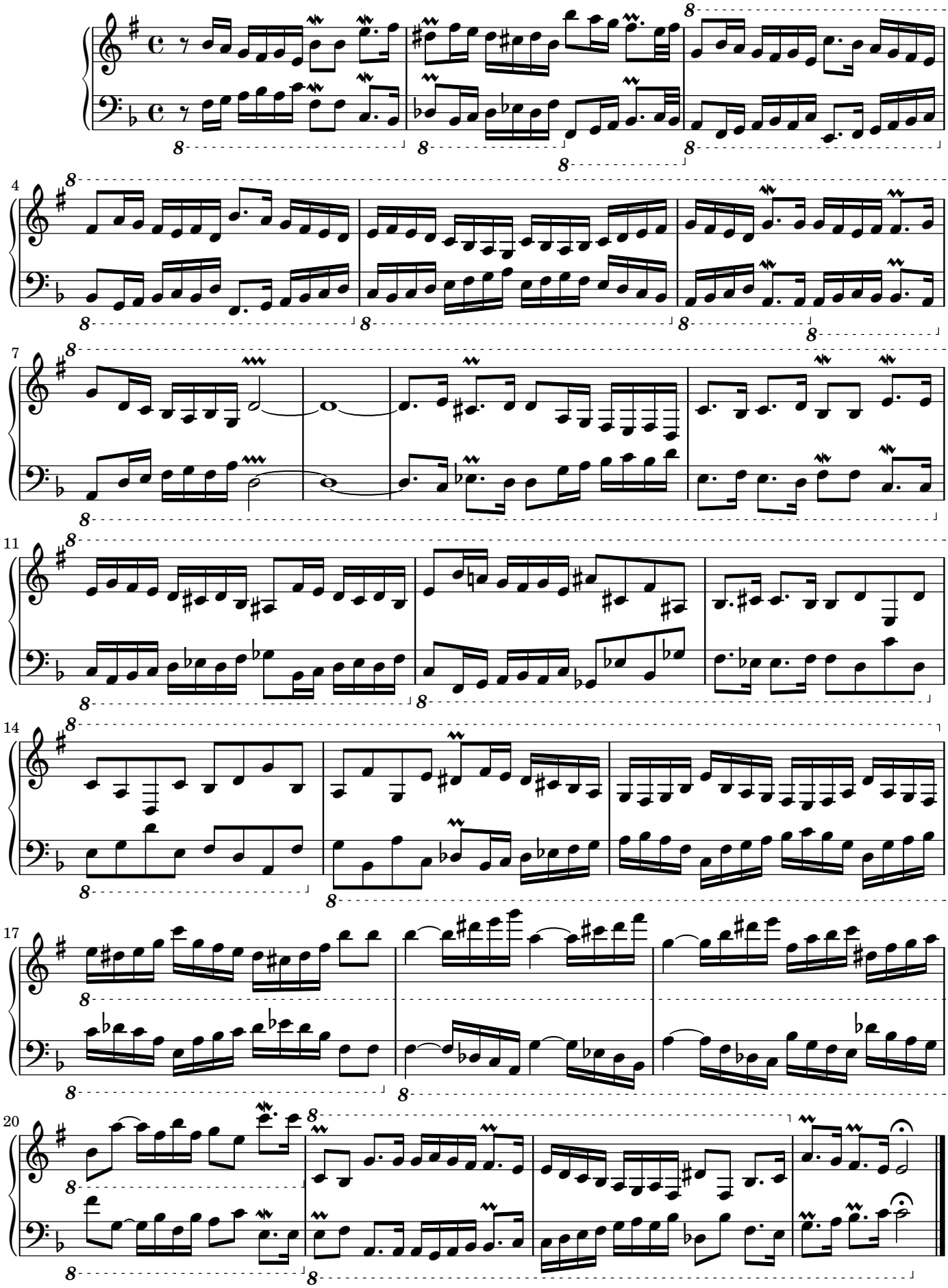
Invention 7, BWV 778

Benjamin Pritchard, after Johann Sebastian Bach

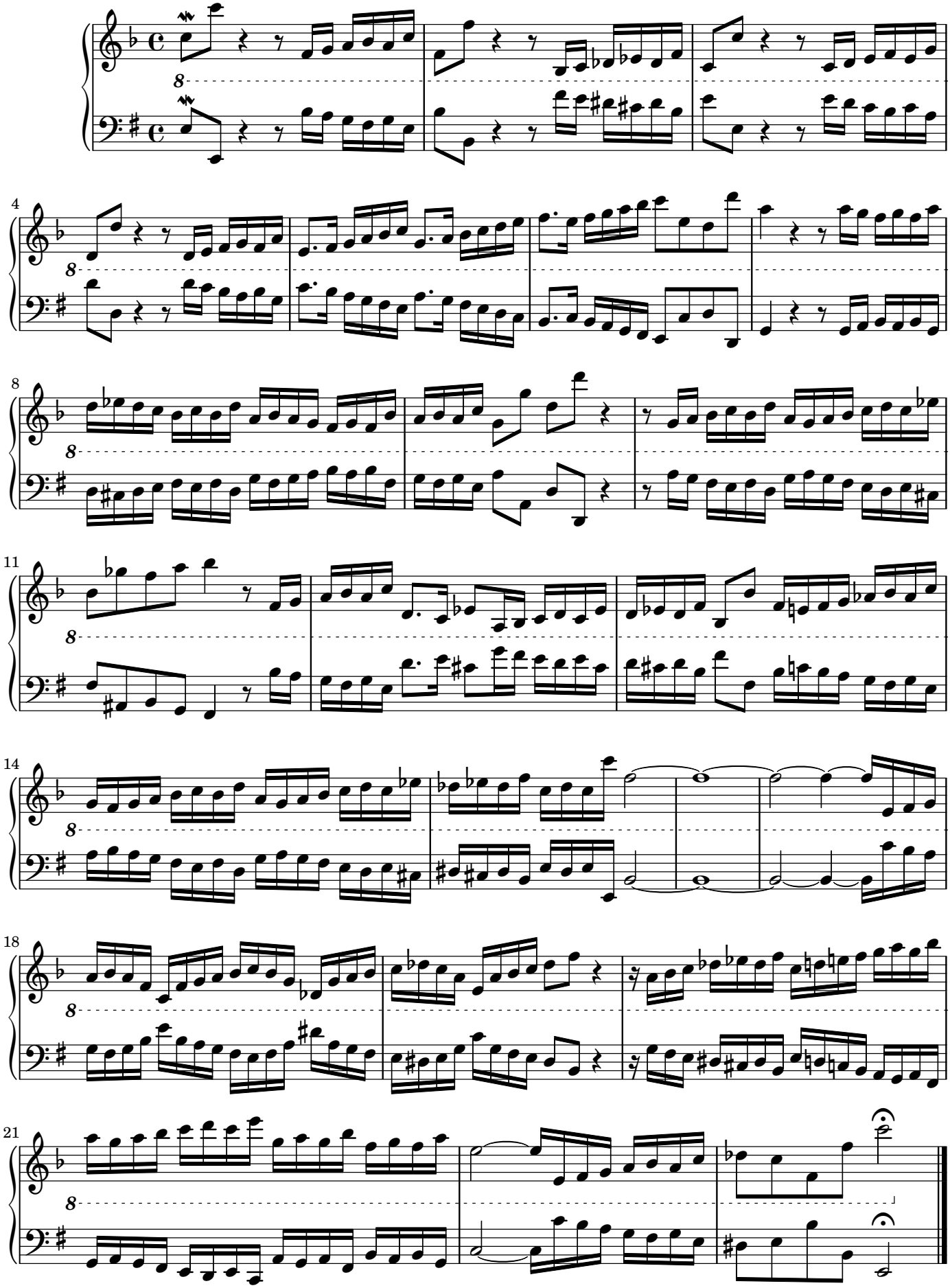
Left Hand Ascending



Invention 7, BWV 778

Benjamin Pritchard, after Johann Sebastian Bach

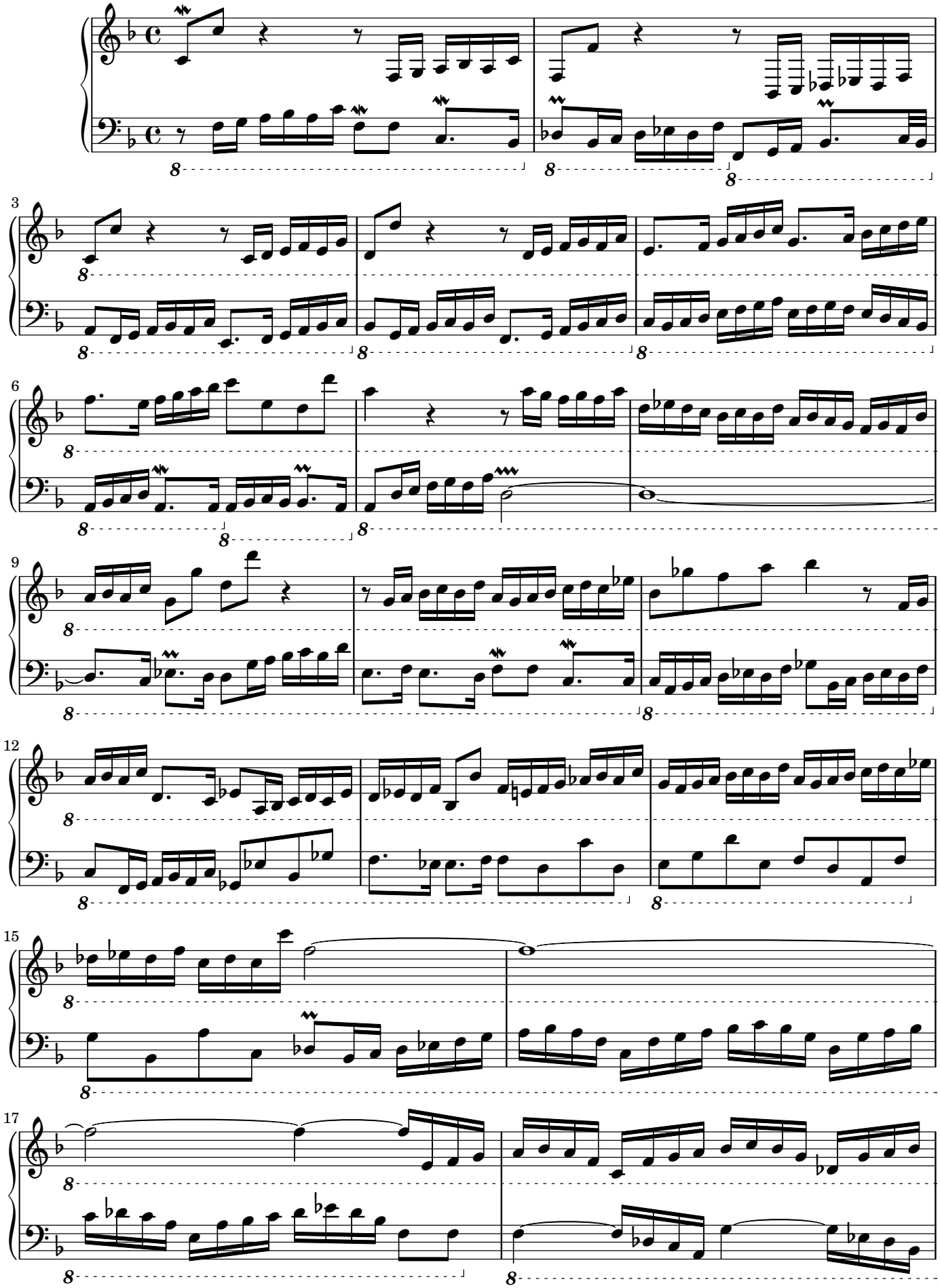
Right Hand Descending

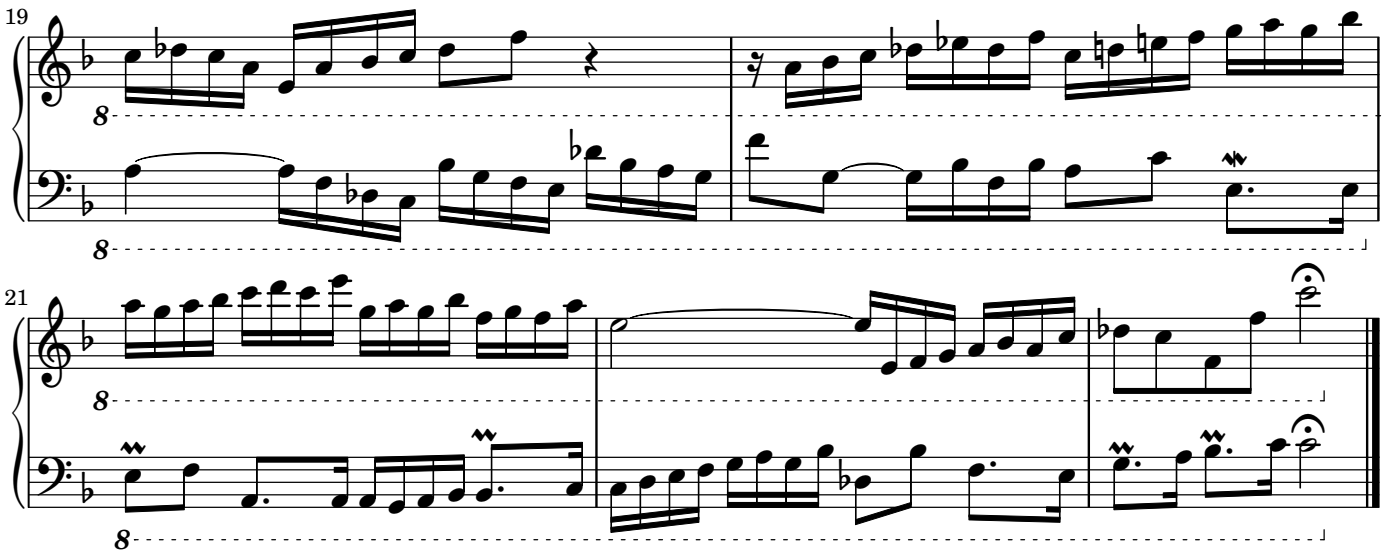


Invention 7, BWV 778

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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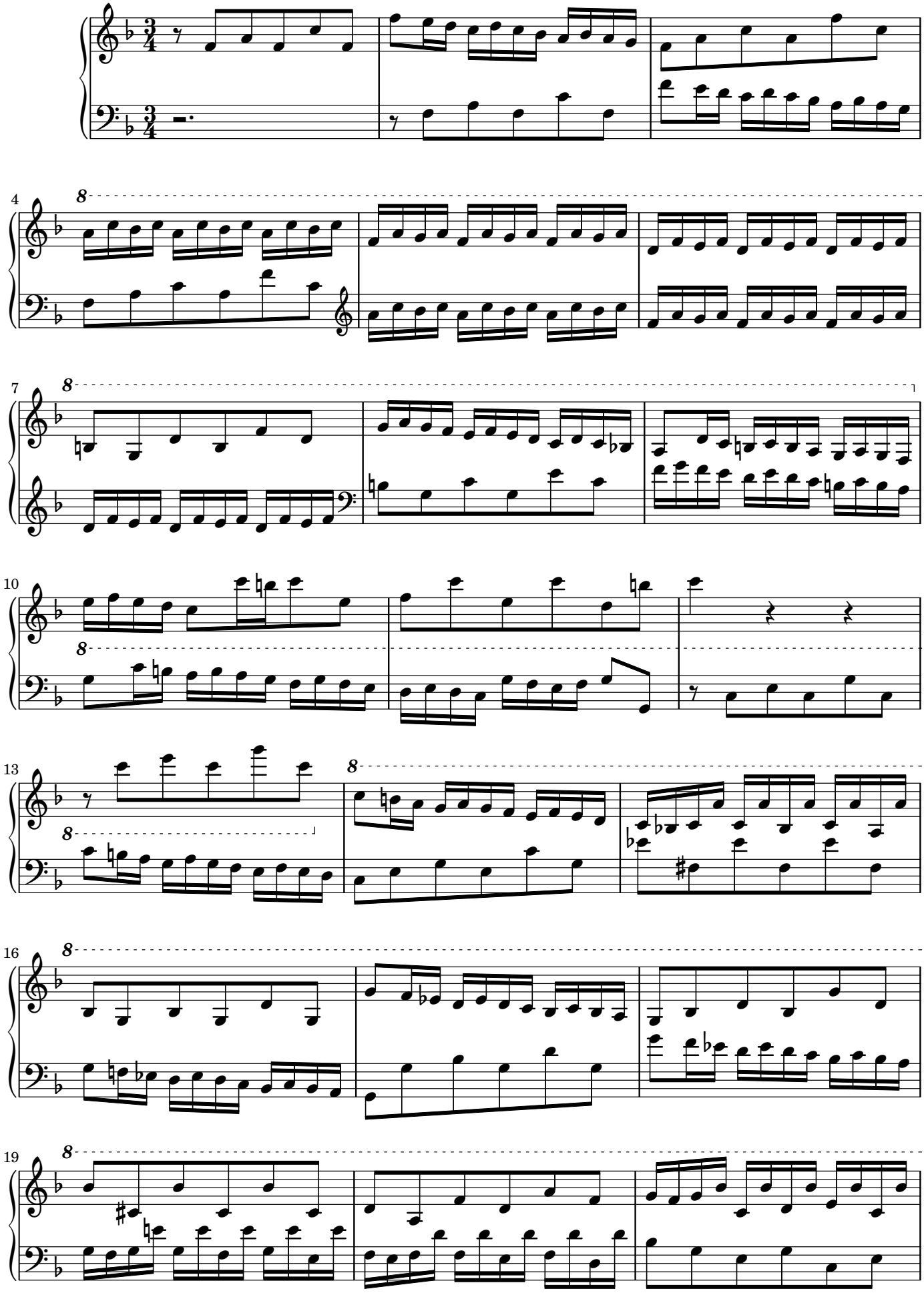
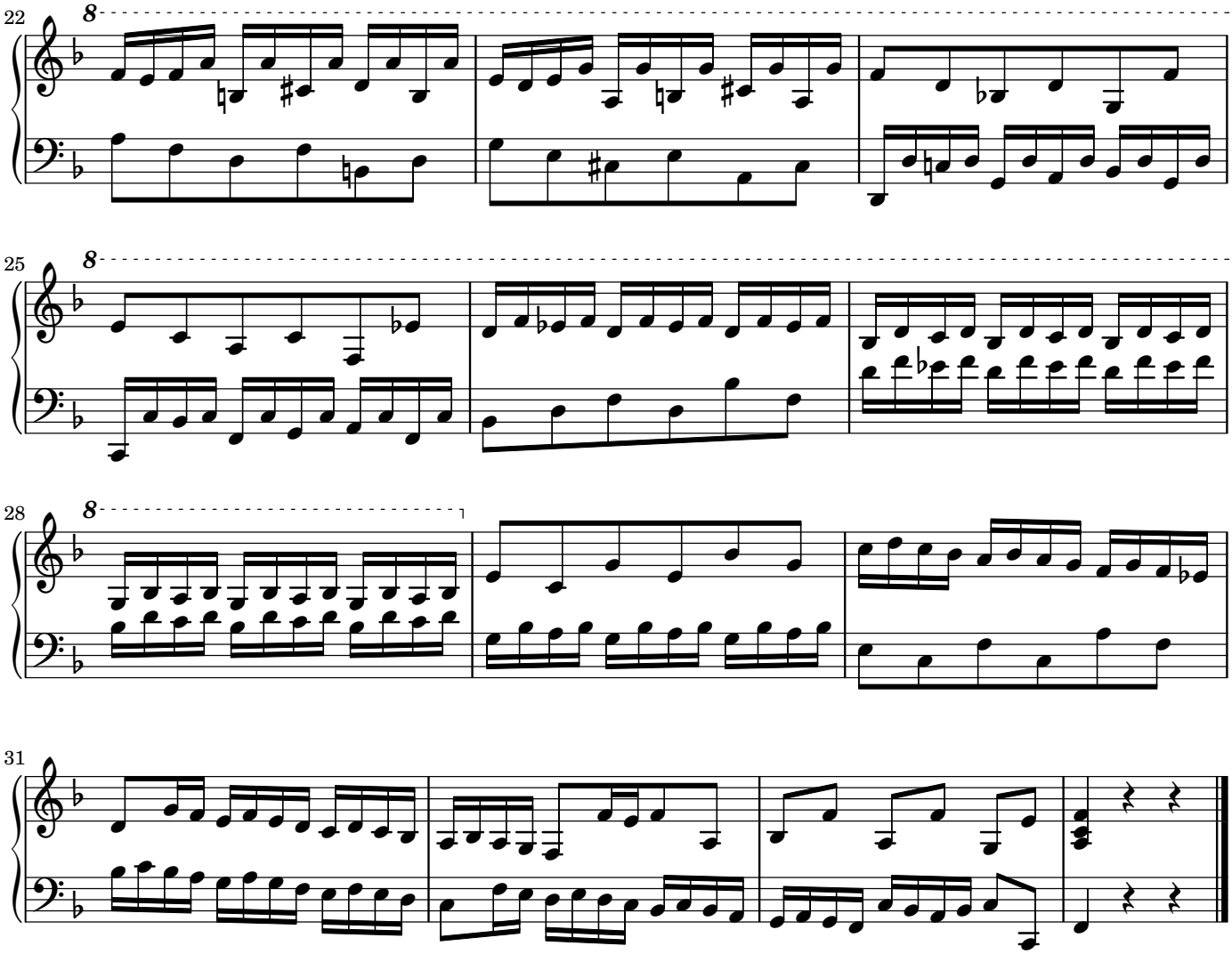
Invention 8, BWV 779

Johann Sebastian Bach

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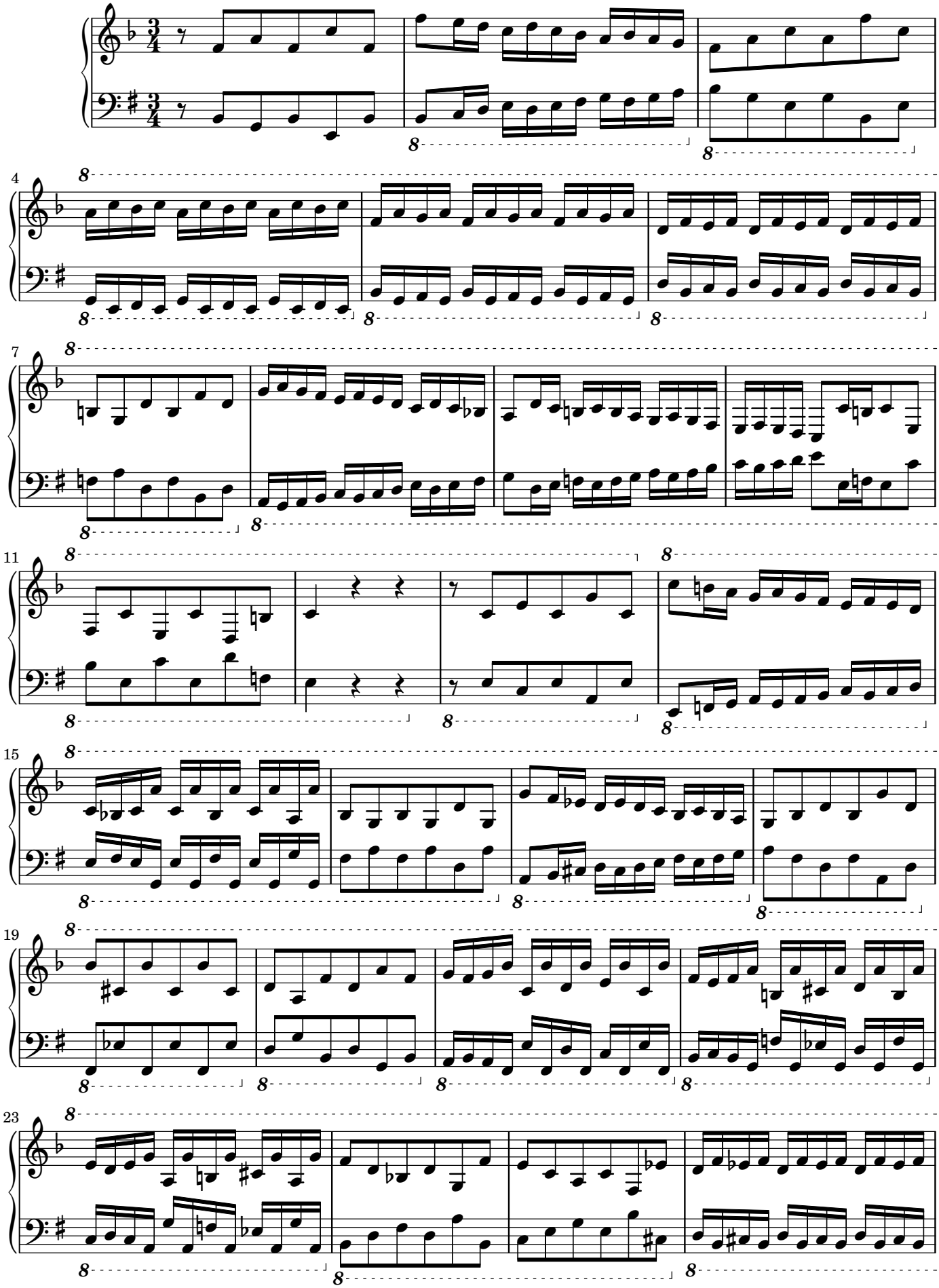
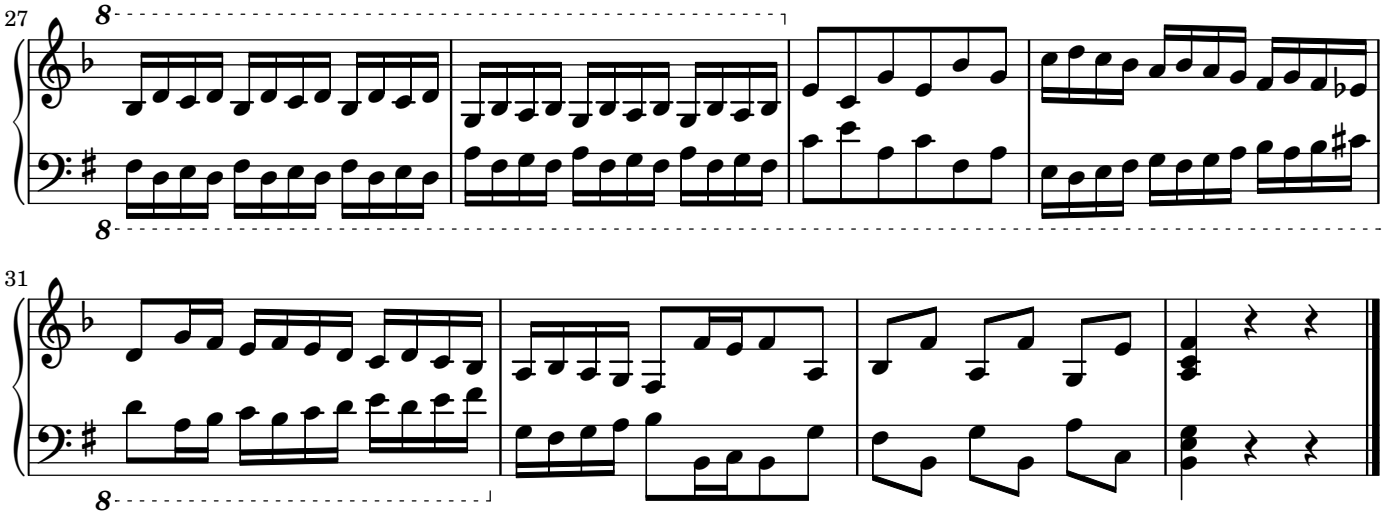
Invention 8, BWV 779

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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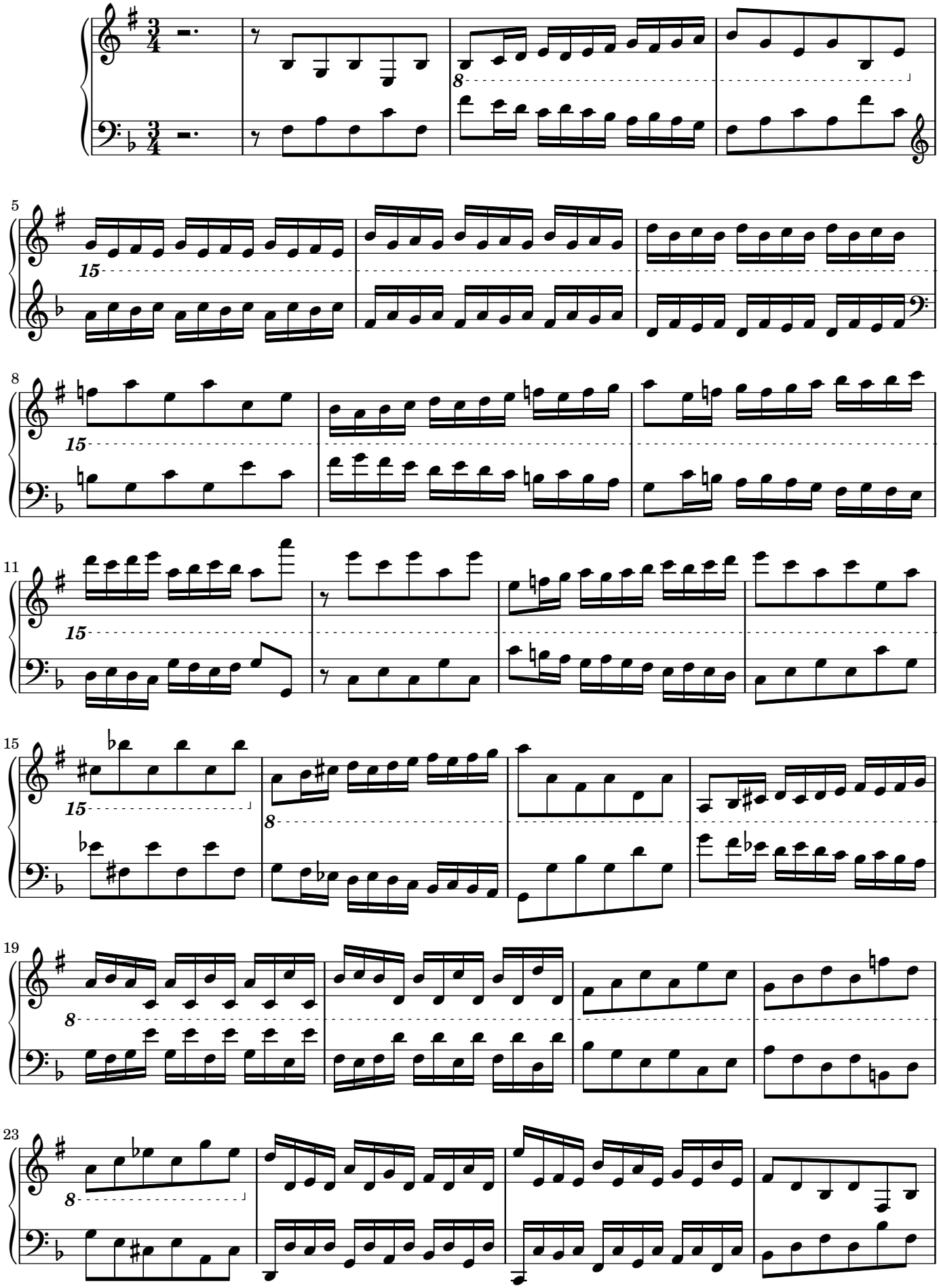
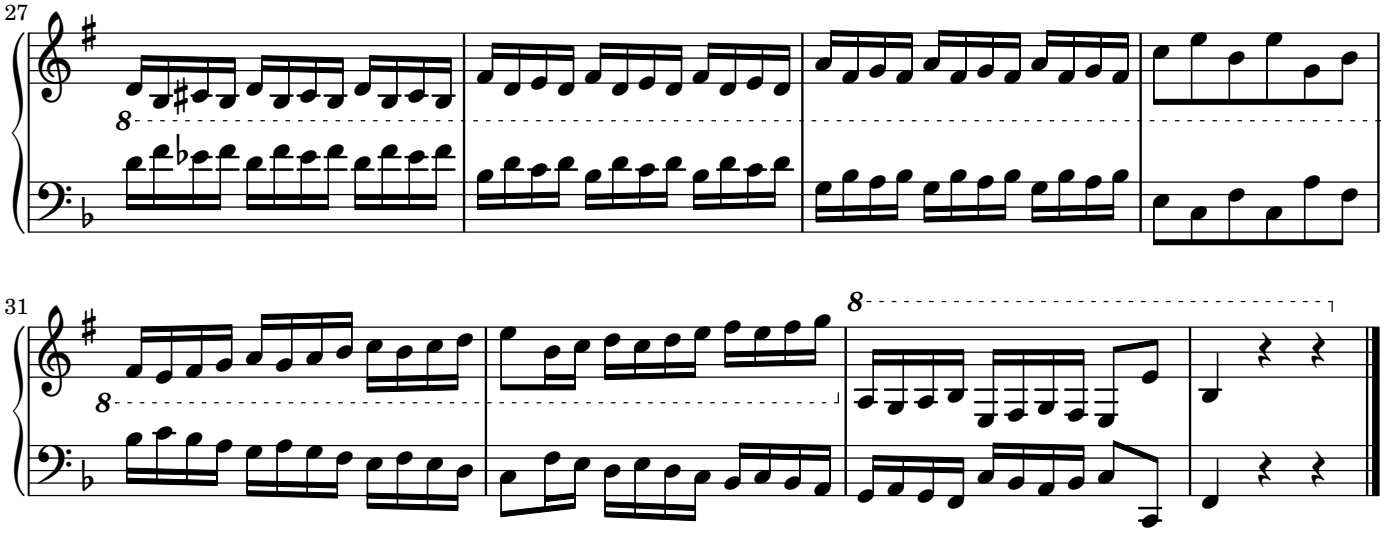
Invention 8, BWV 779

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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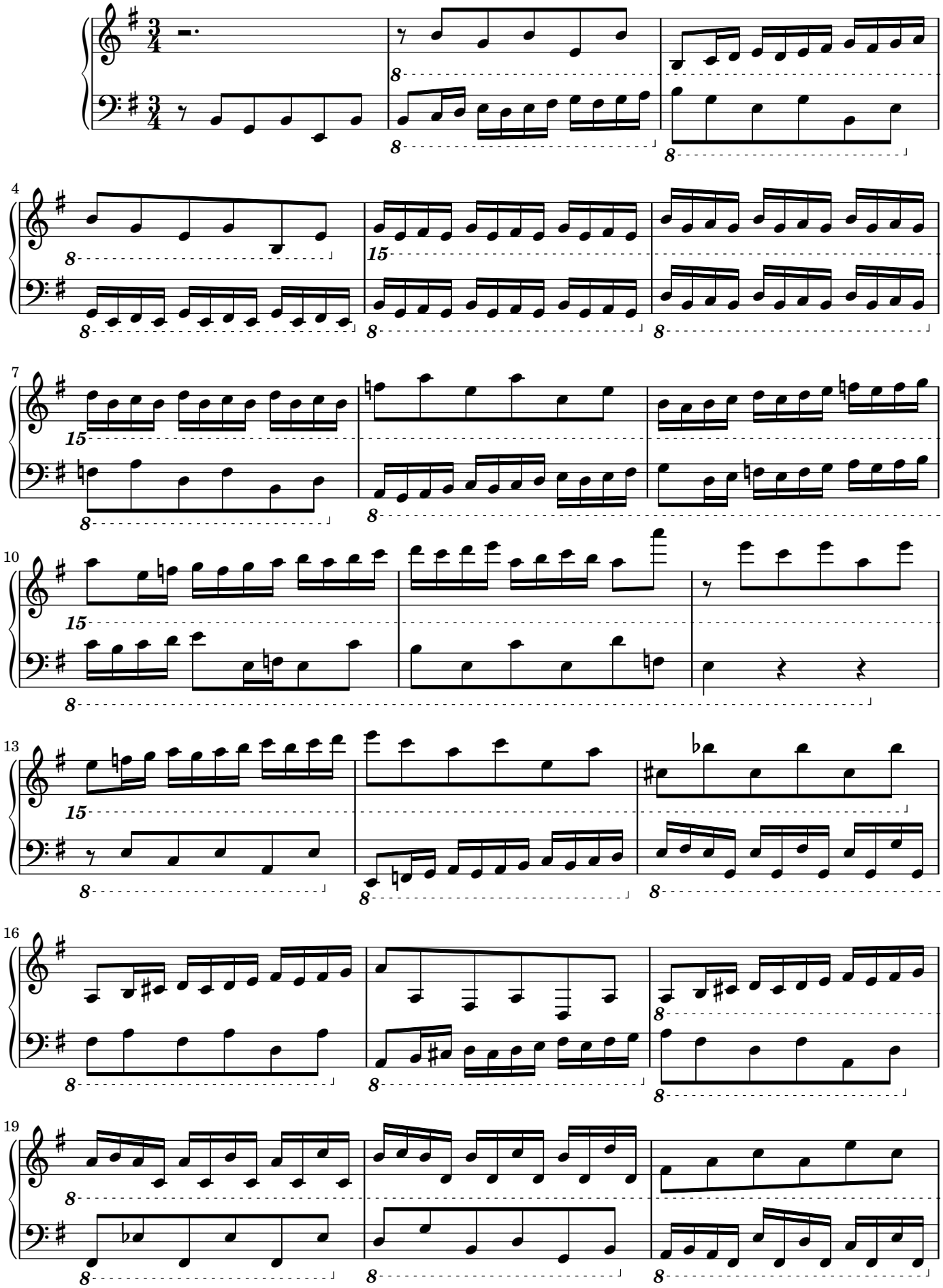
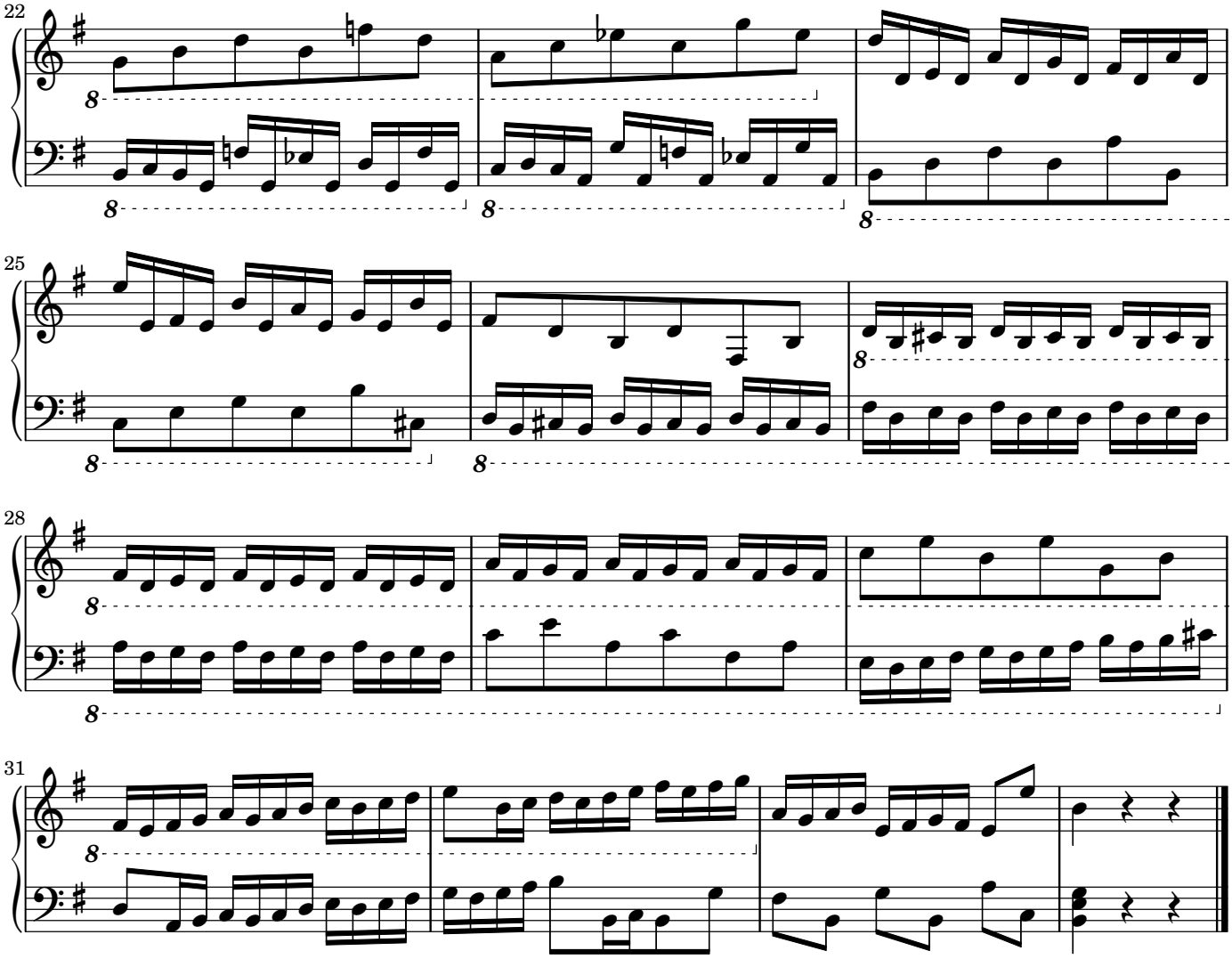
Invention 8, BWV 779

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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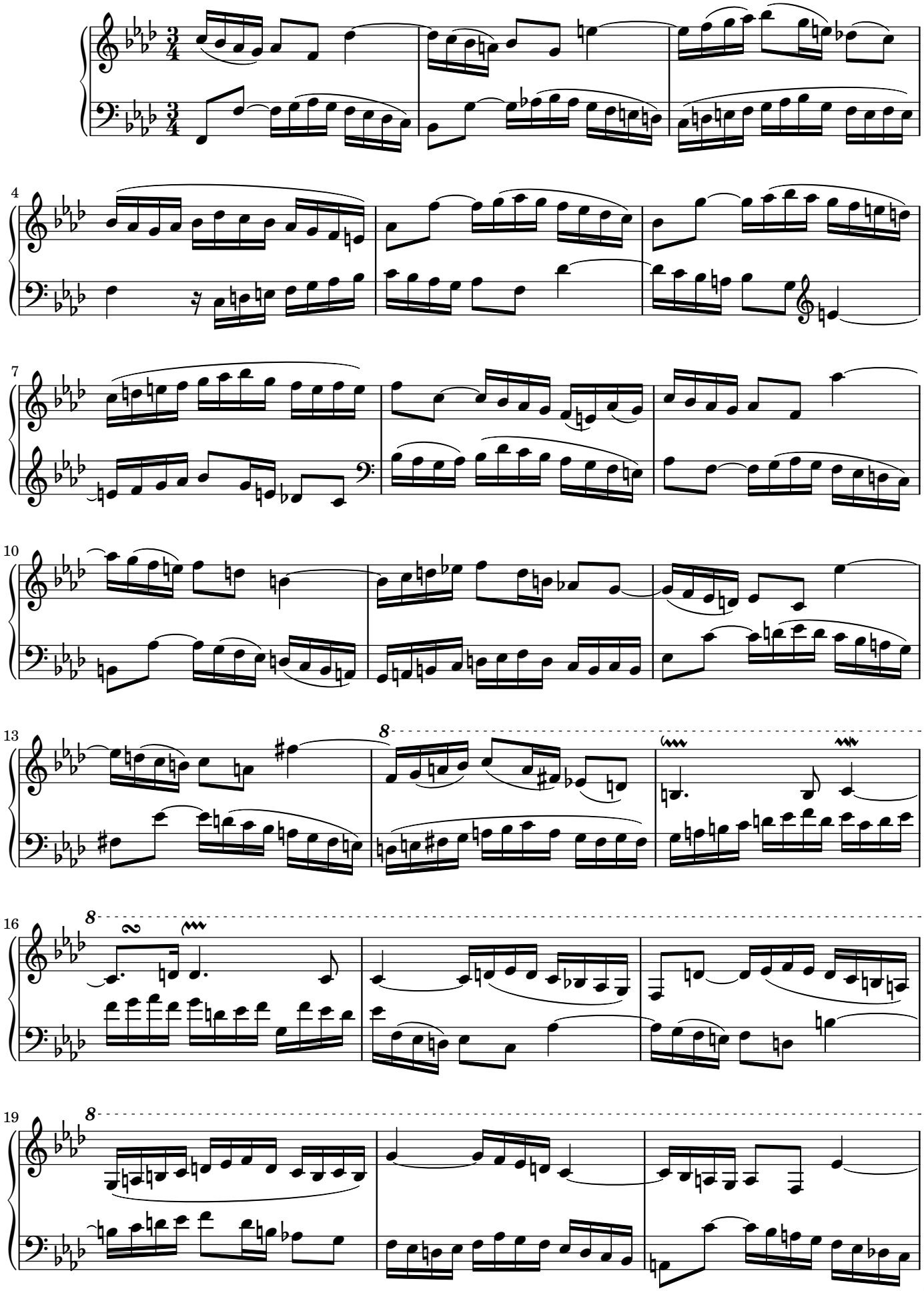
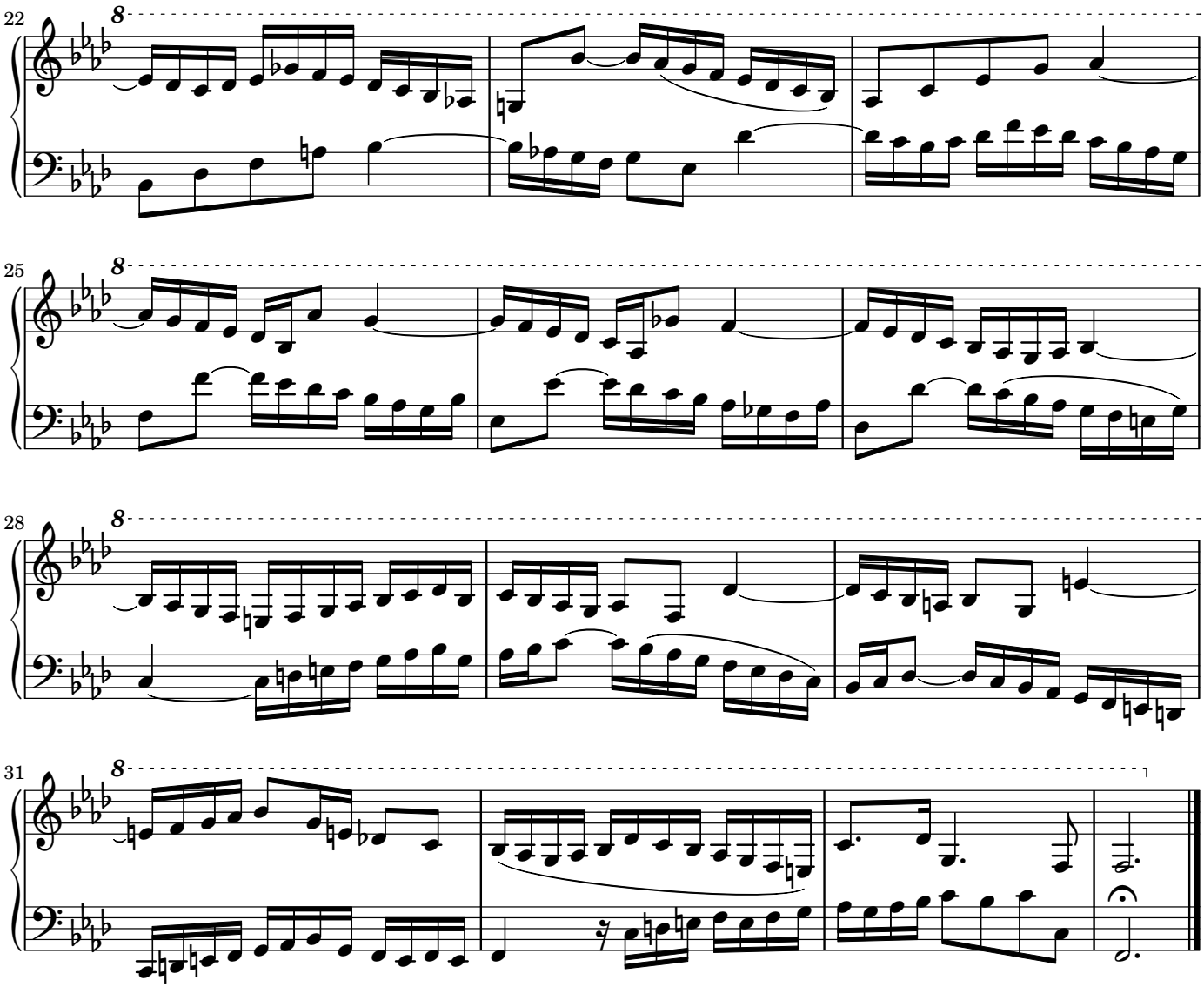
Invention 9, BWV 780

Johann Sebastian Bach

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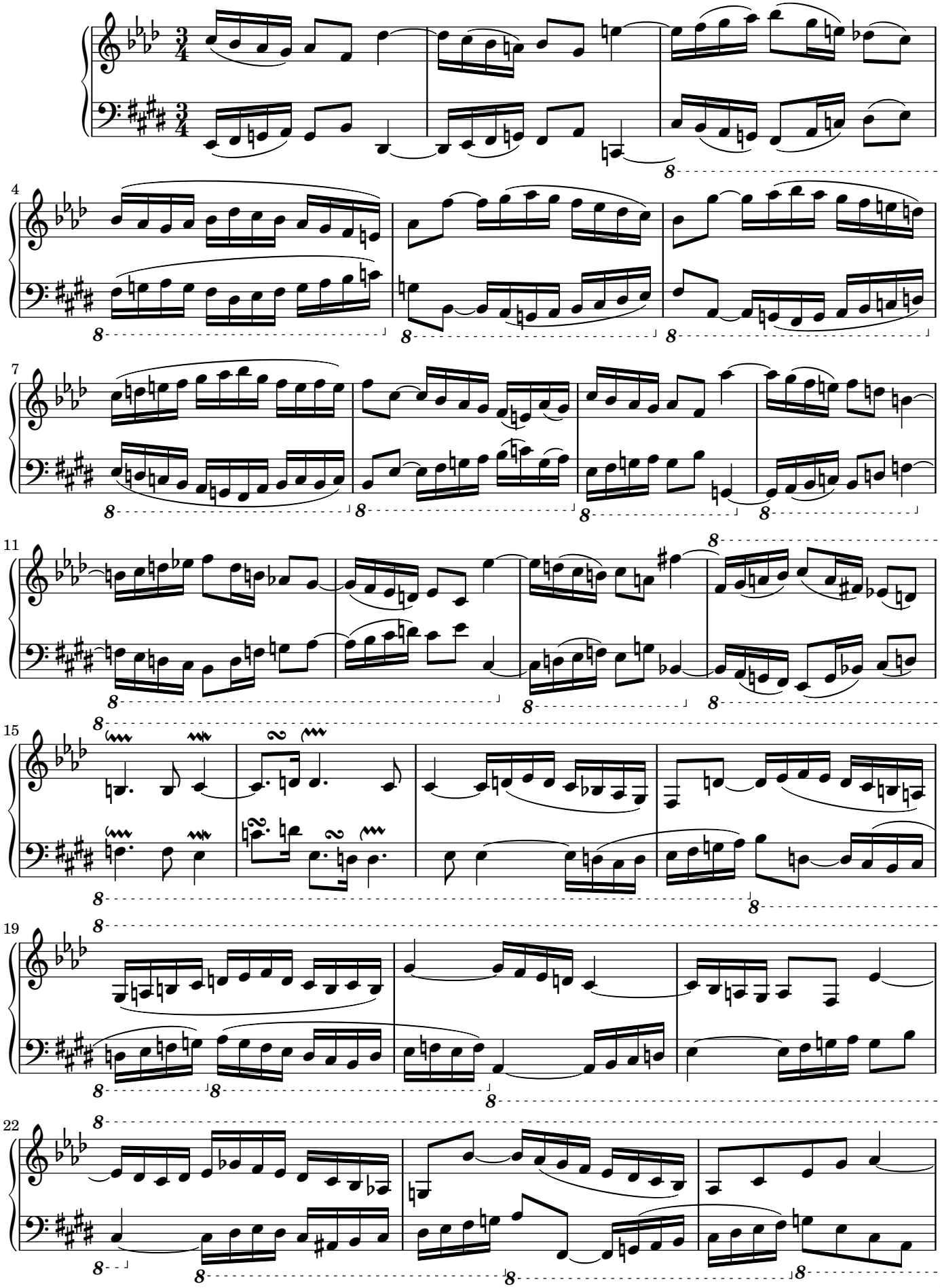
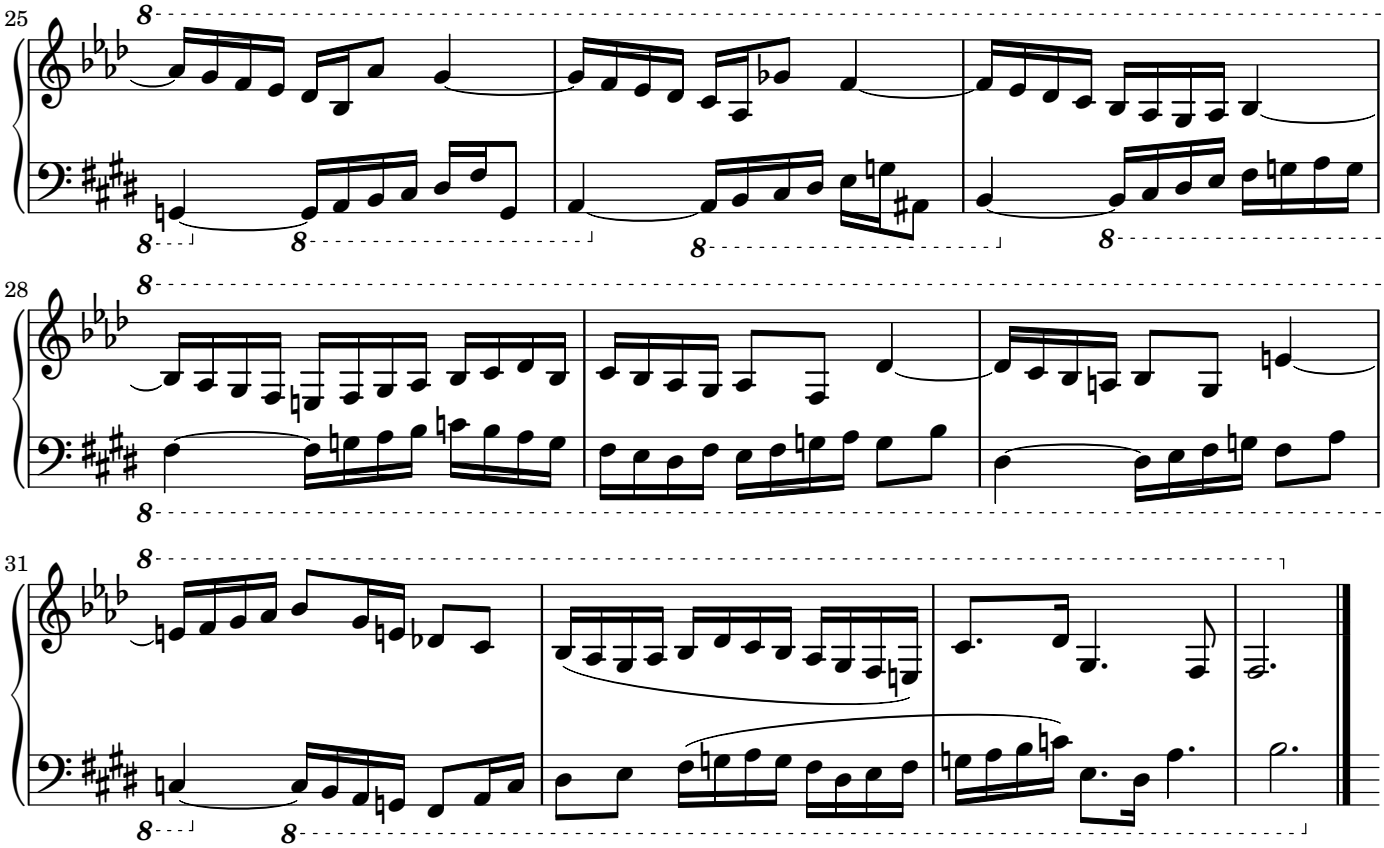
Invention 9, BWV 780

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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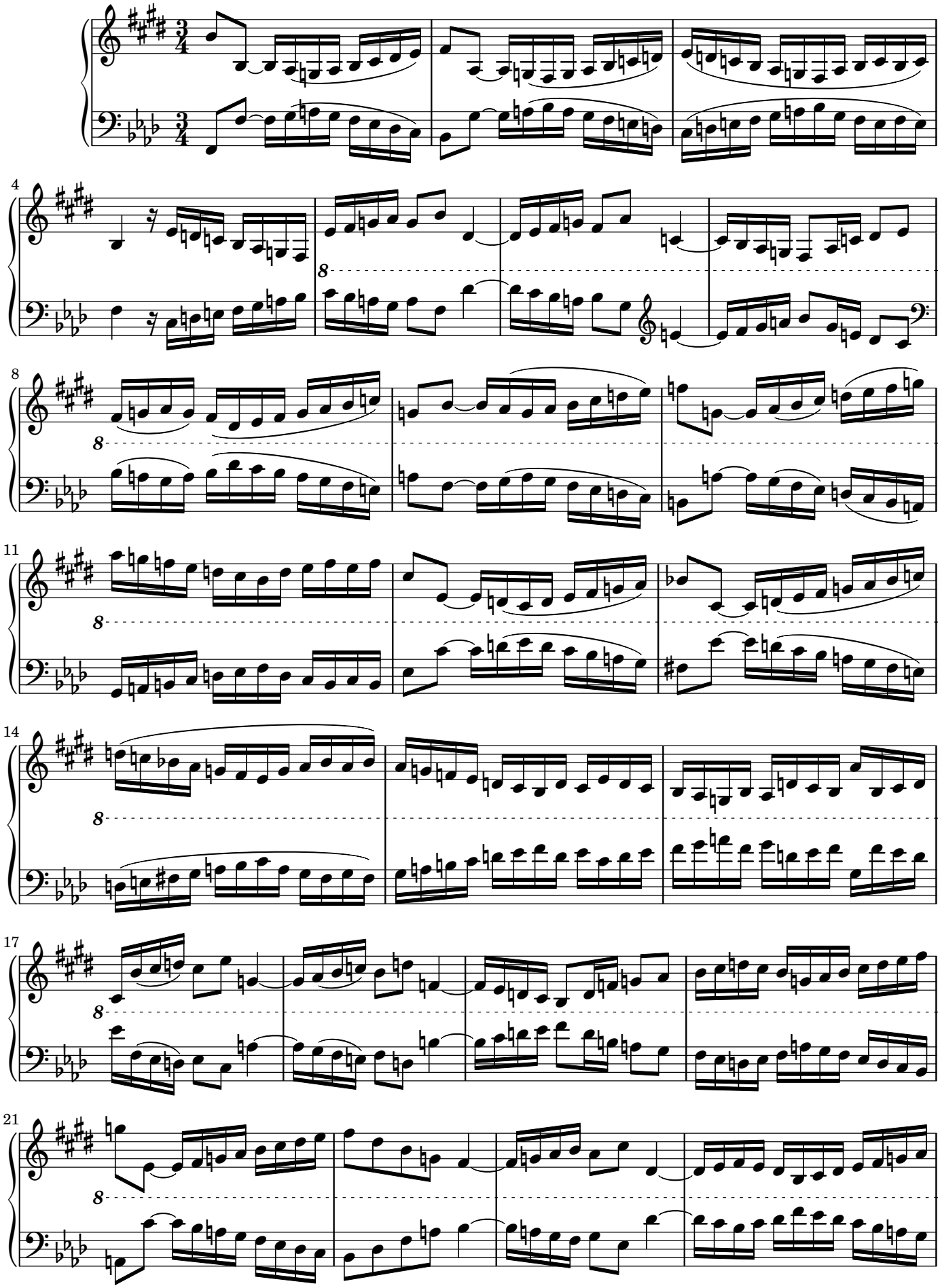
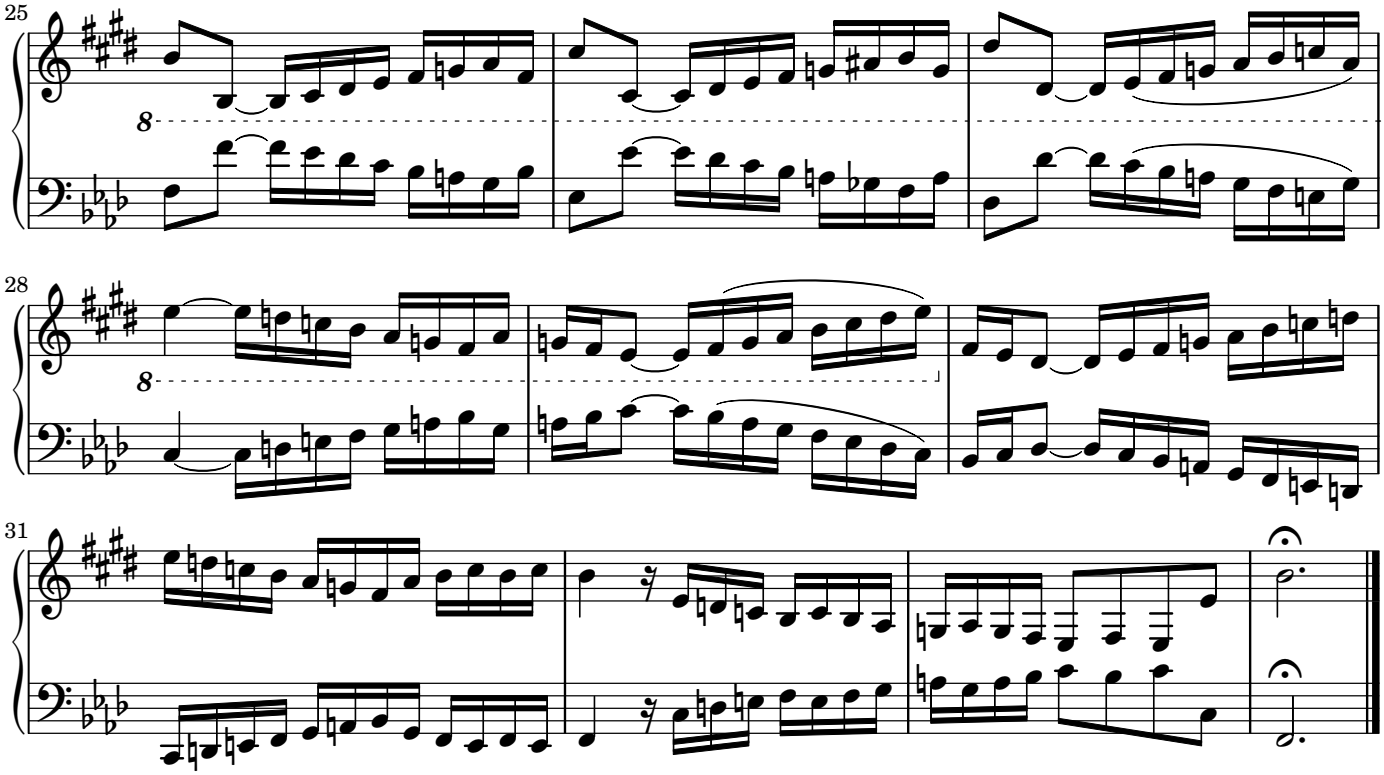
Invention 9, BWV 780

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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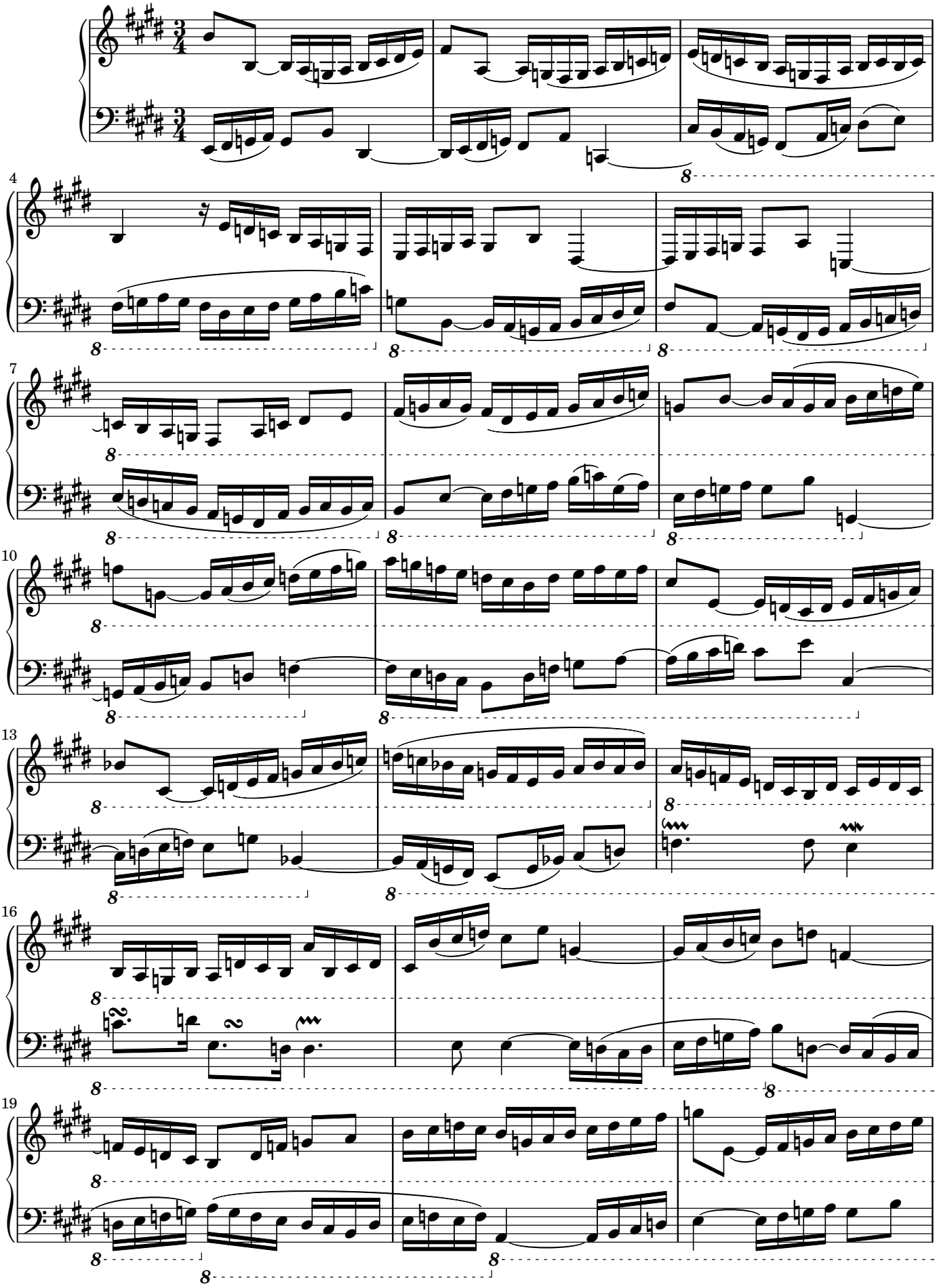
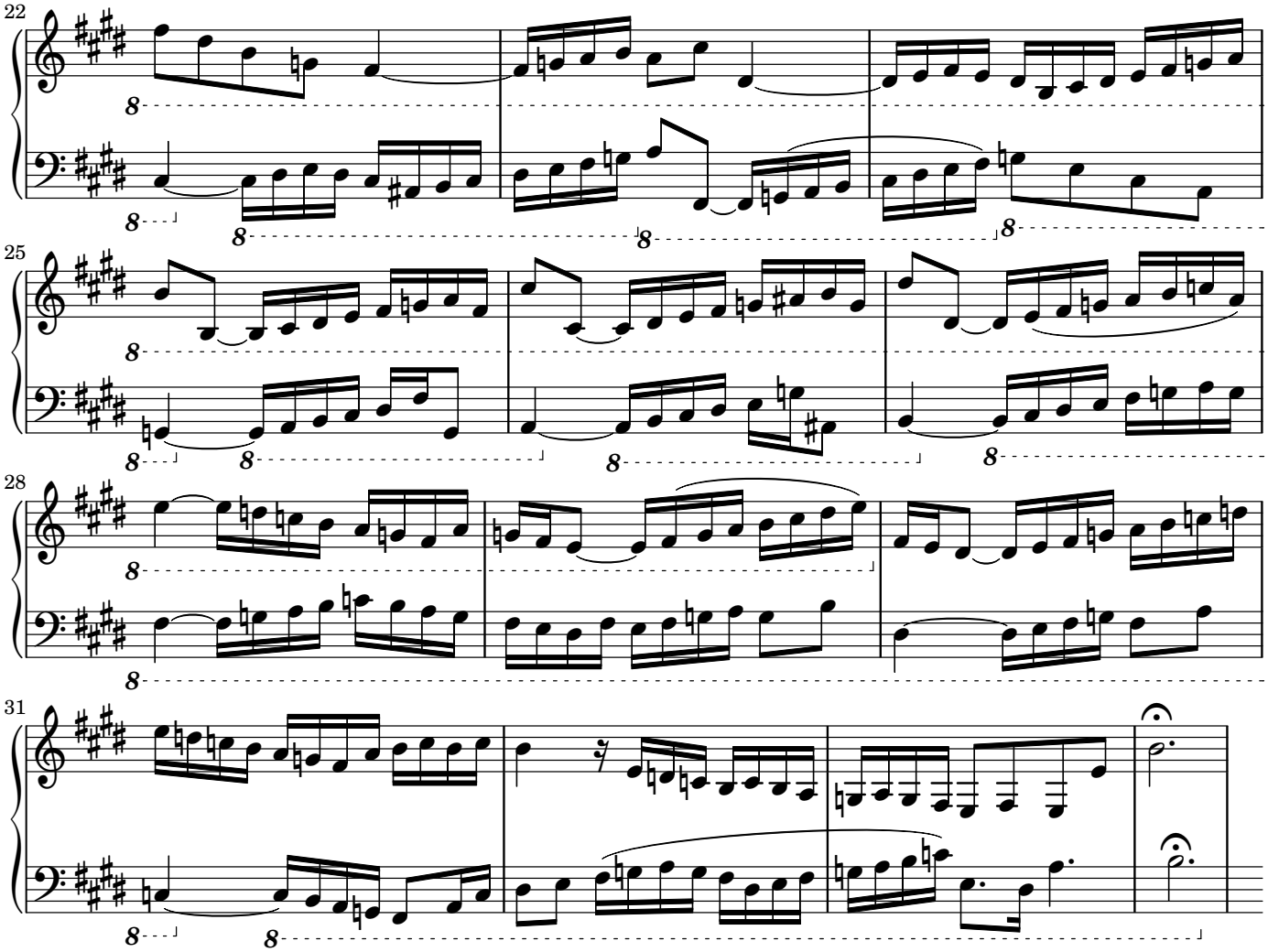
Invention 9, BWV 780

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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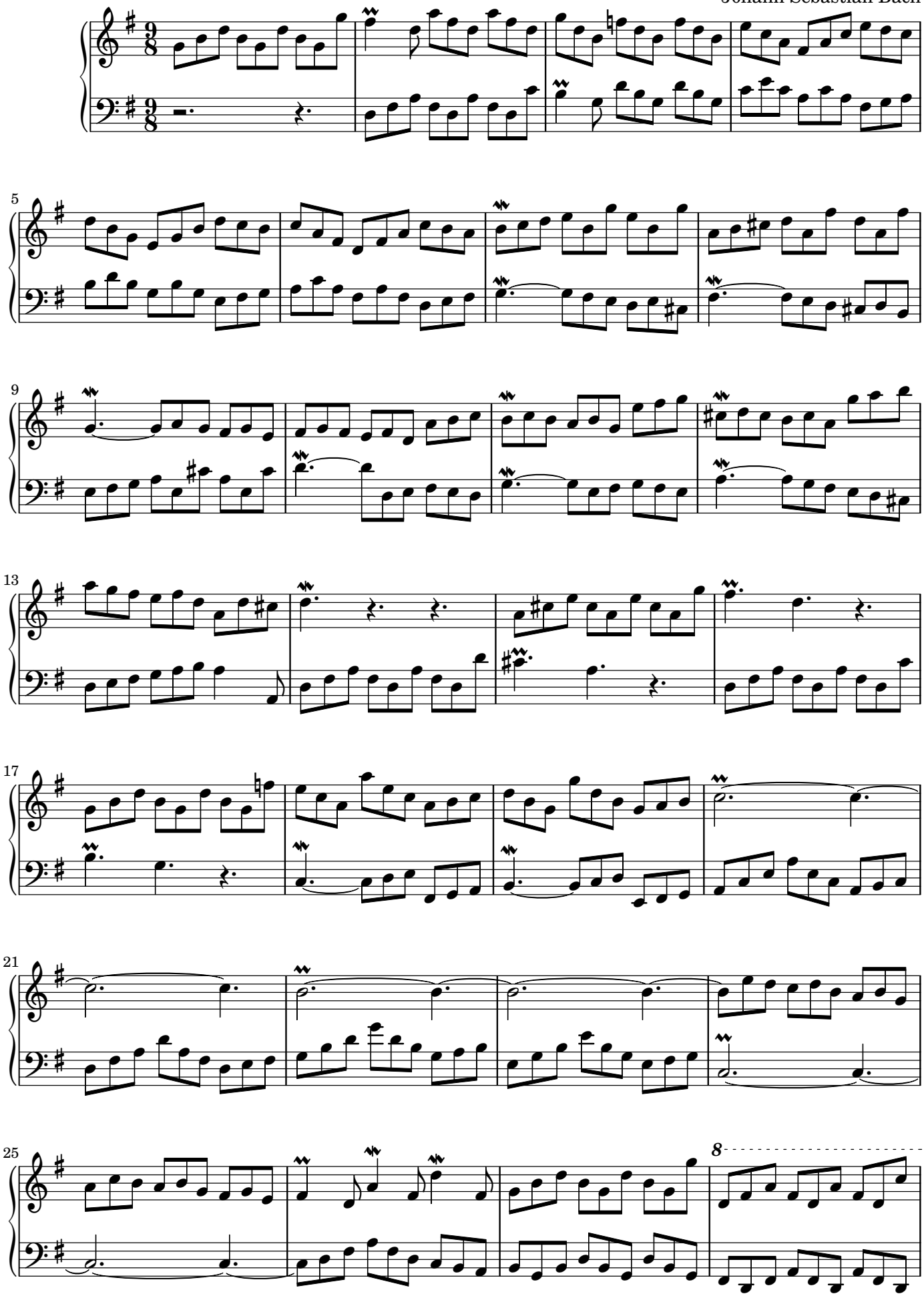
Invention 10, BWV 781

Johann Sebastian Bach



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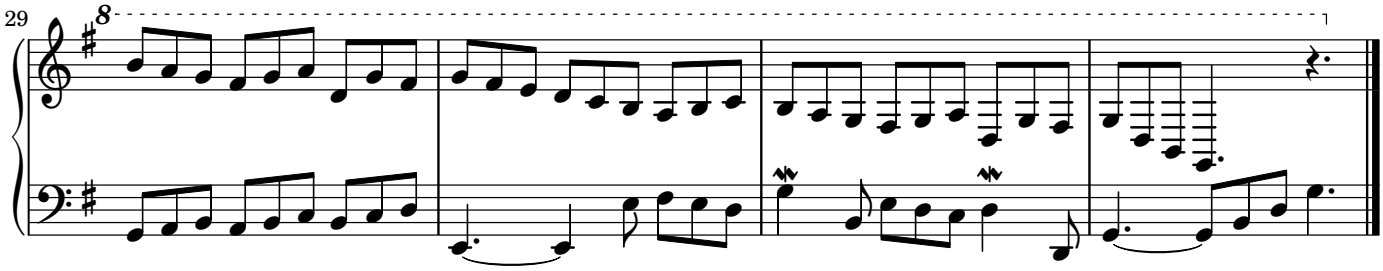
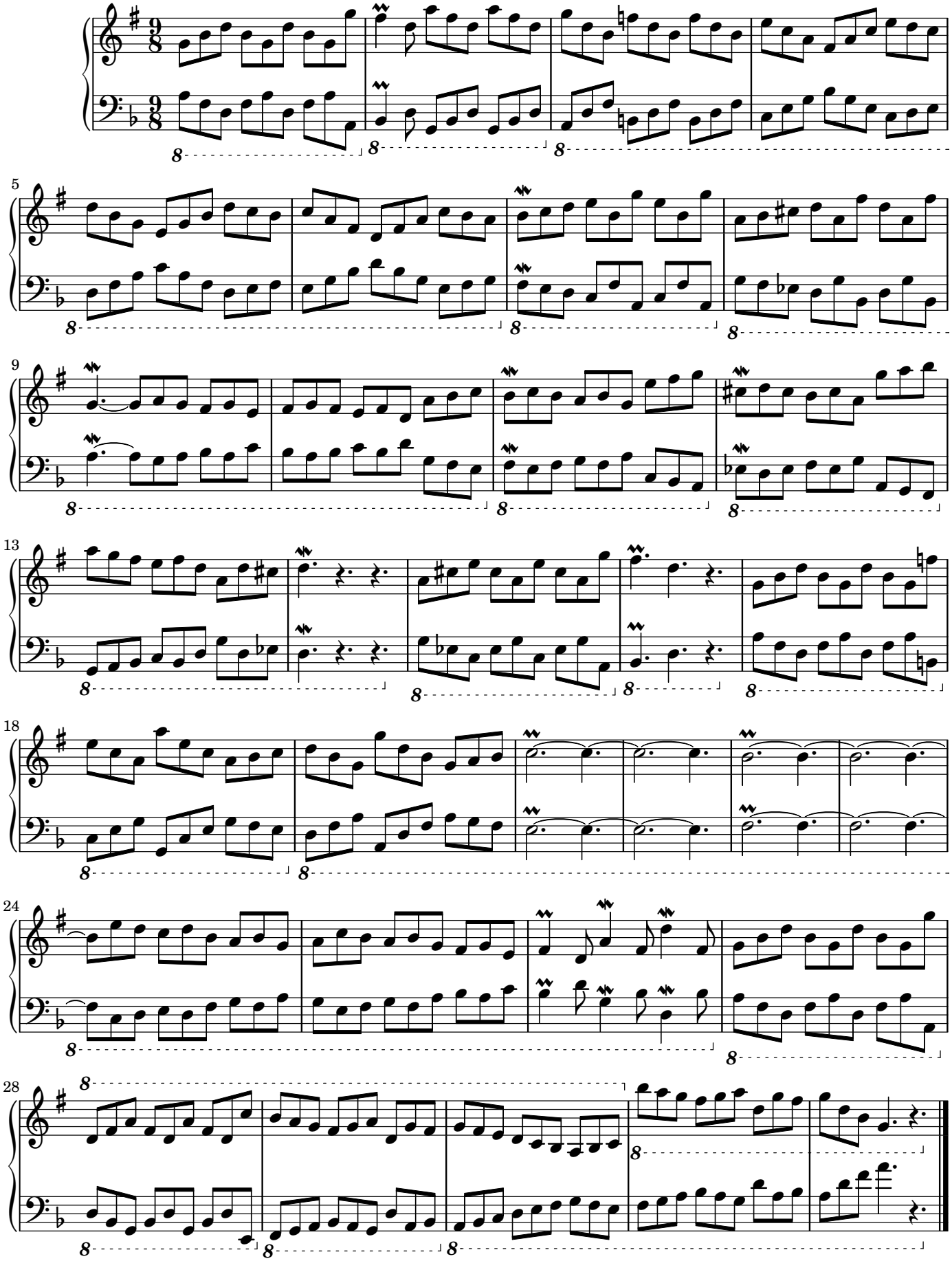


Invention 10, BWV 781

Benjamin Pritchard, after Johann Sebastian Bach

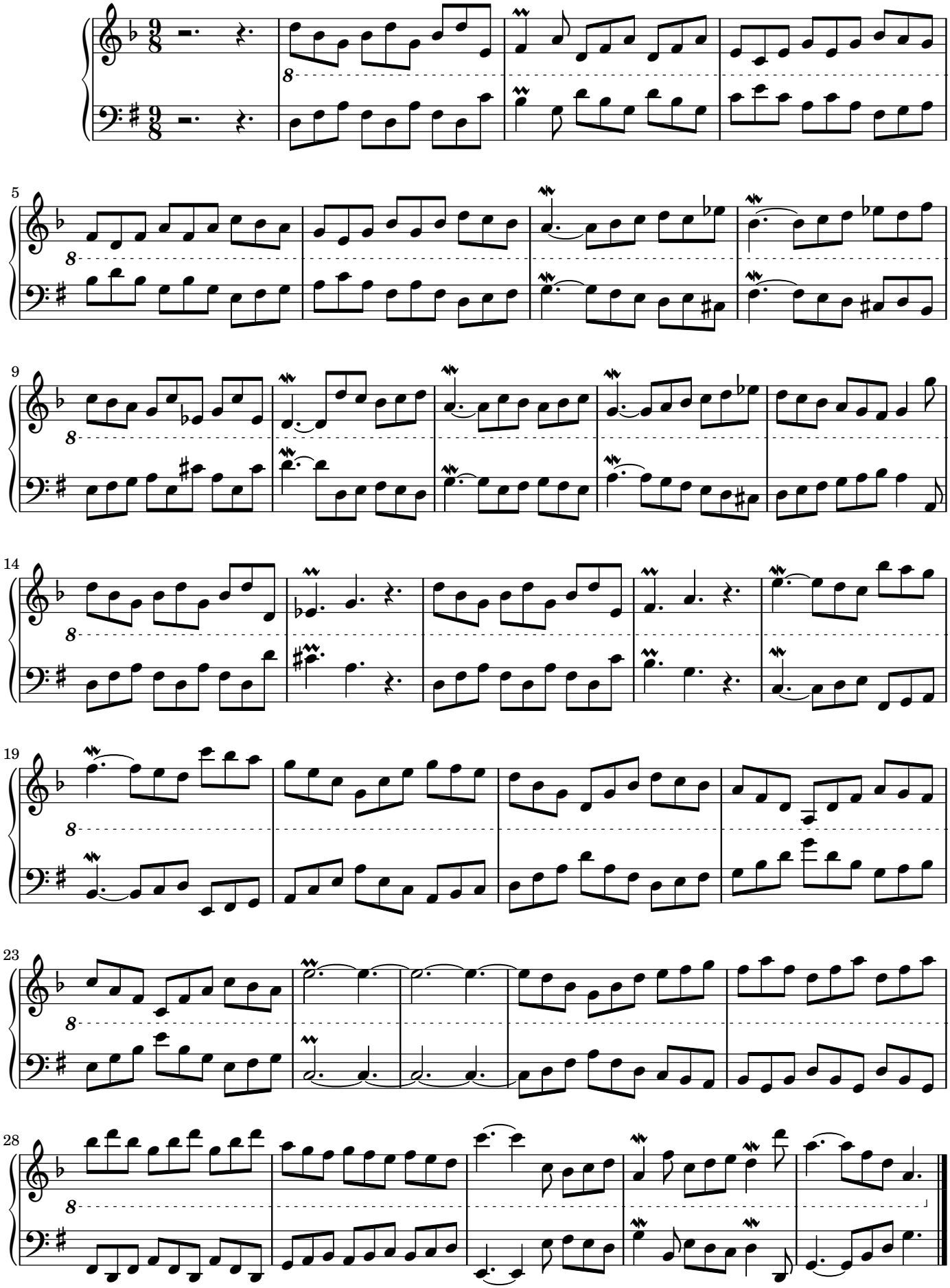
Left Hand Ascending



Invention 10, BWV 781

Benjamin Pritchard, after Johann Sebastian Bach

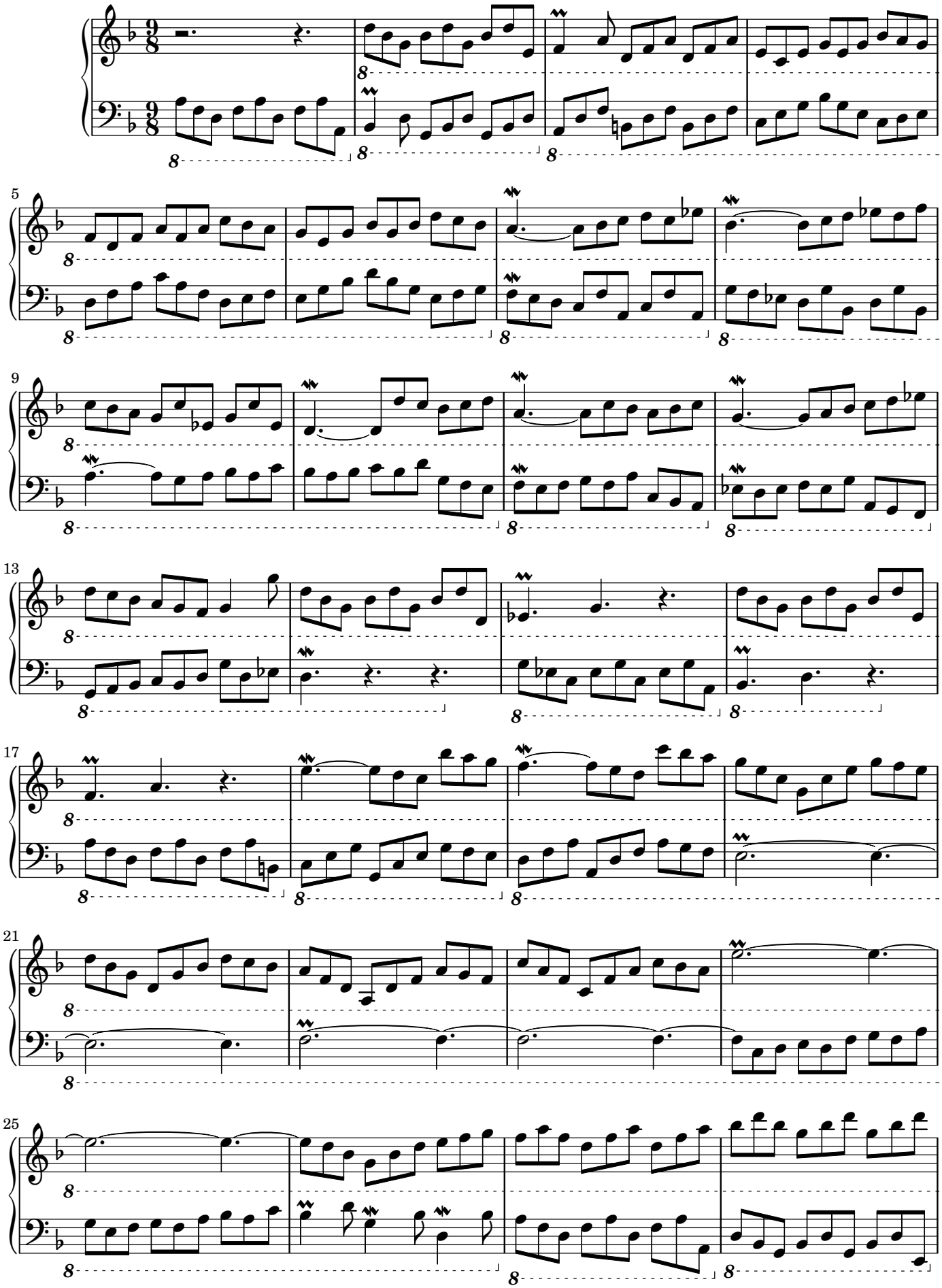
Right Hand Descending

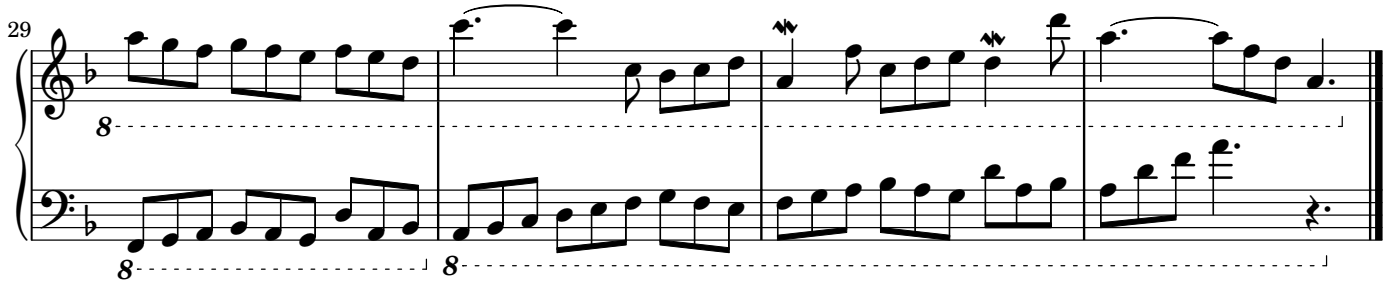


Invention 10, BWV 781

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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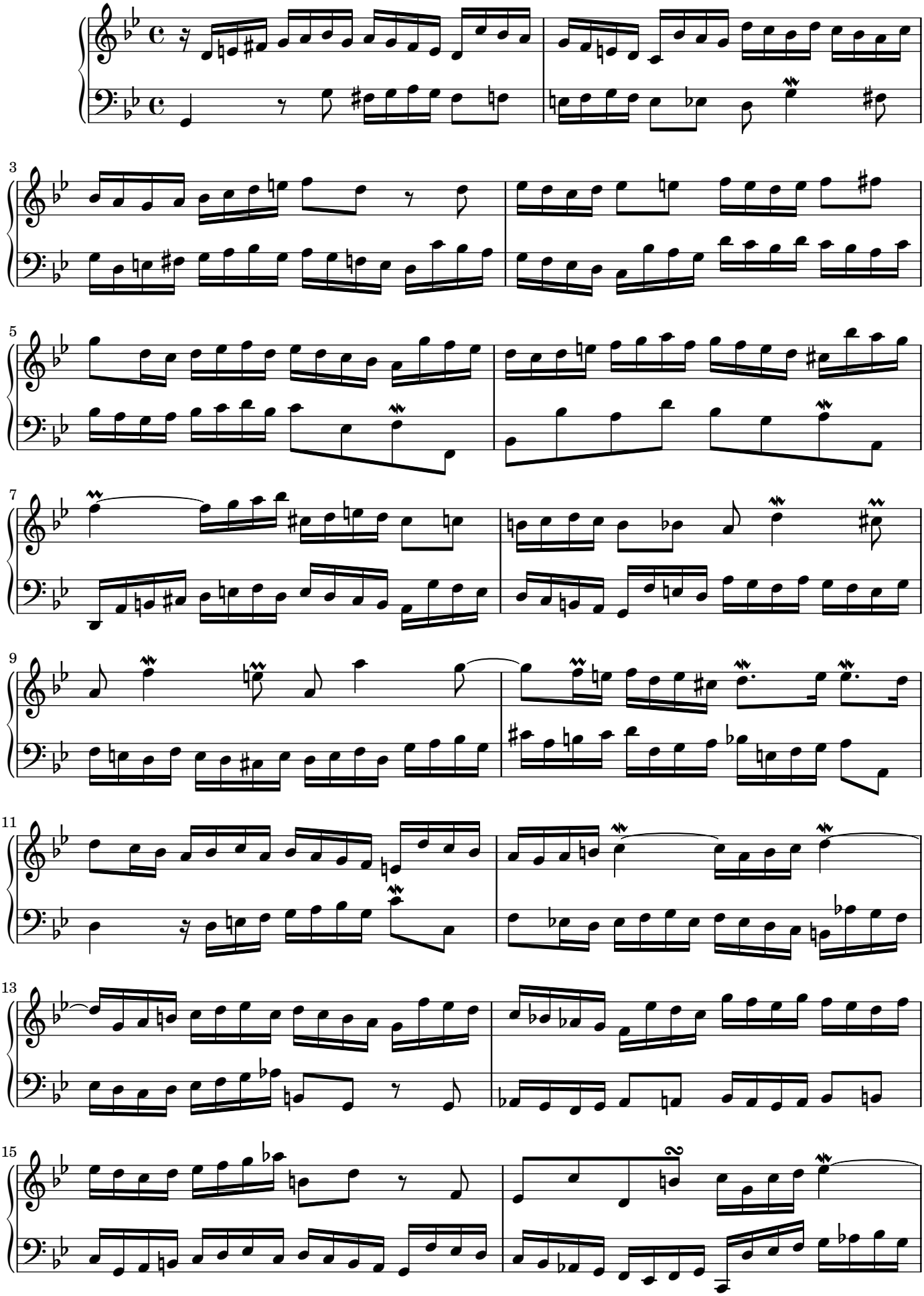
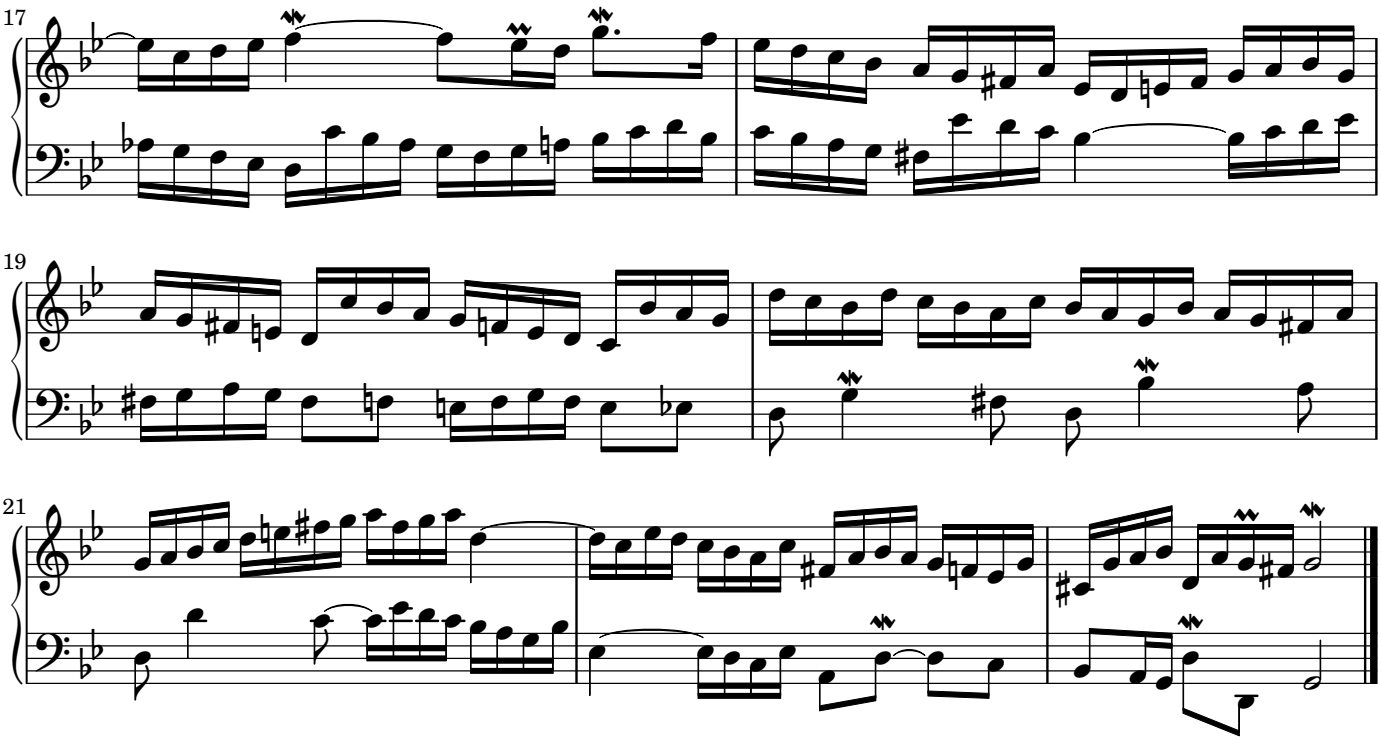
Invention 11, BWV 782

Johann Sebastian Bach

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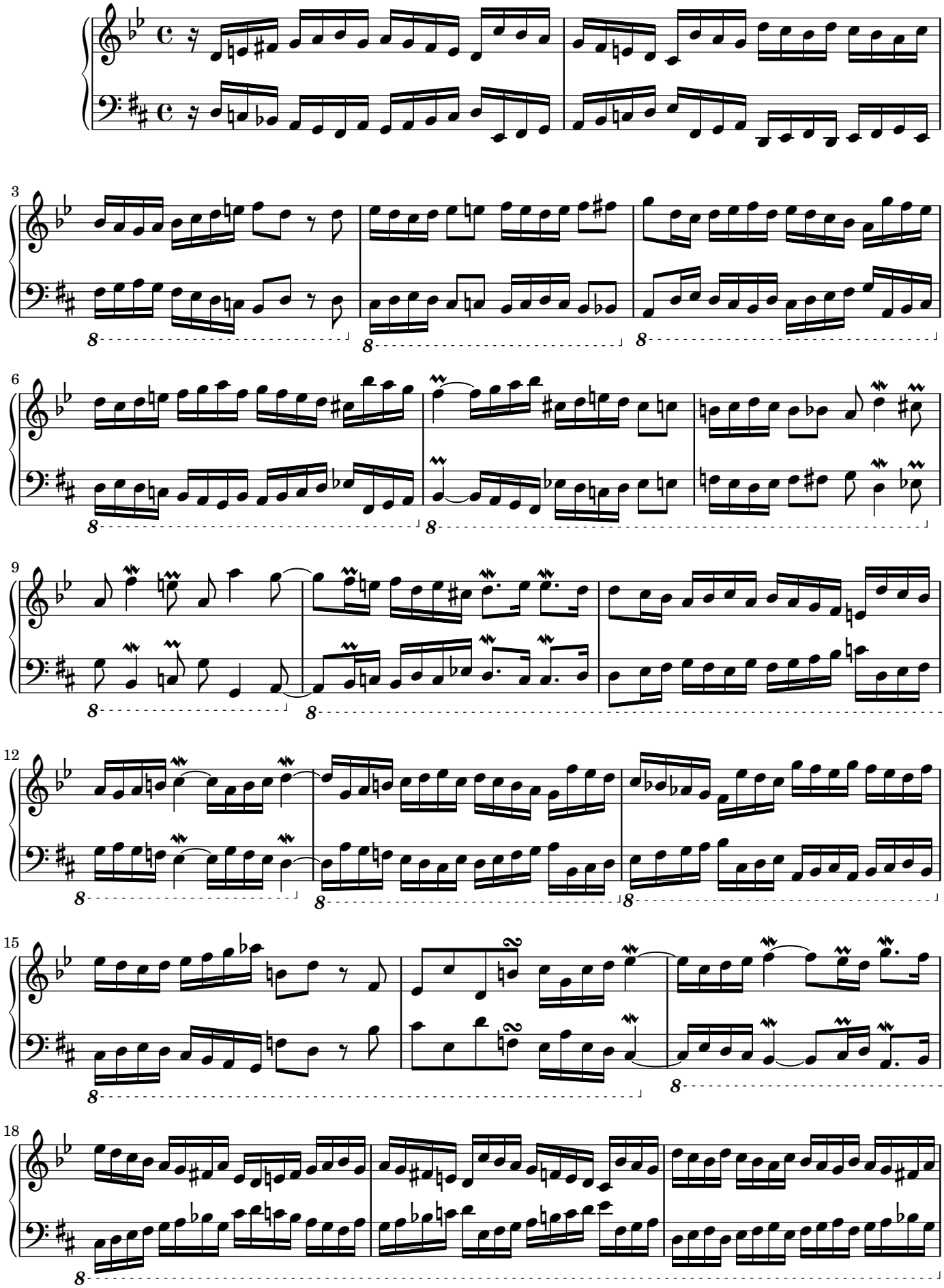
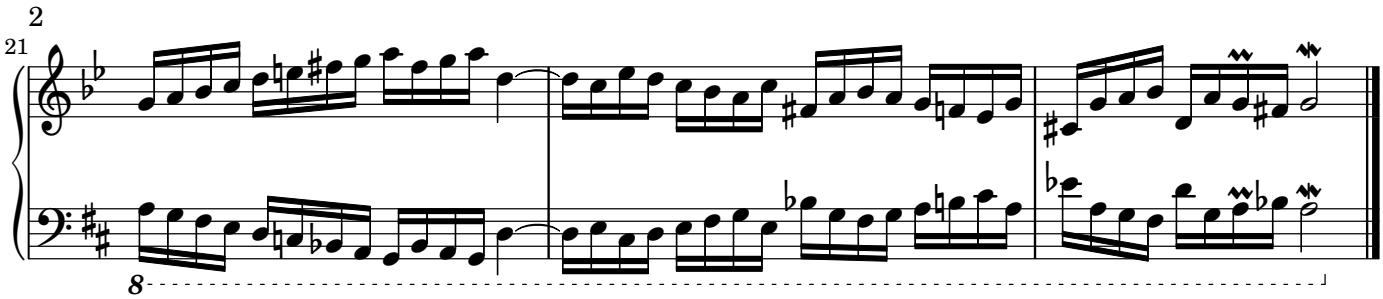
Invention 11, BWV 782

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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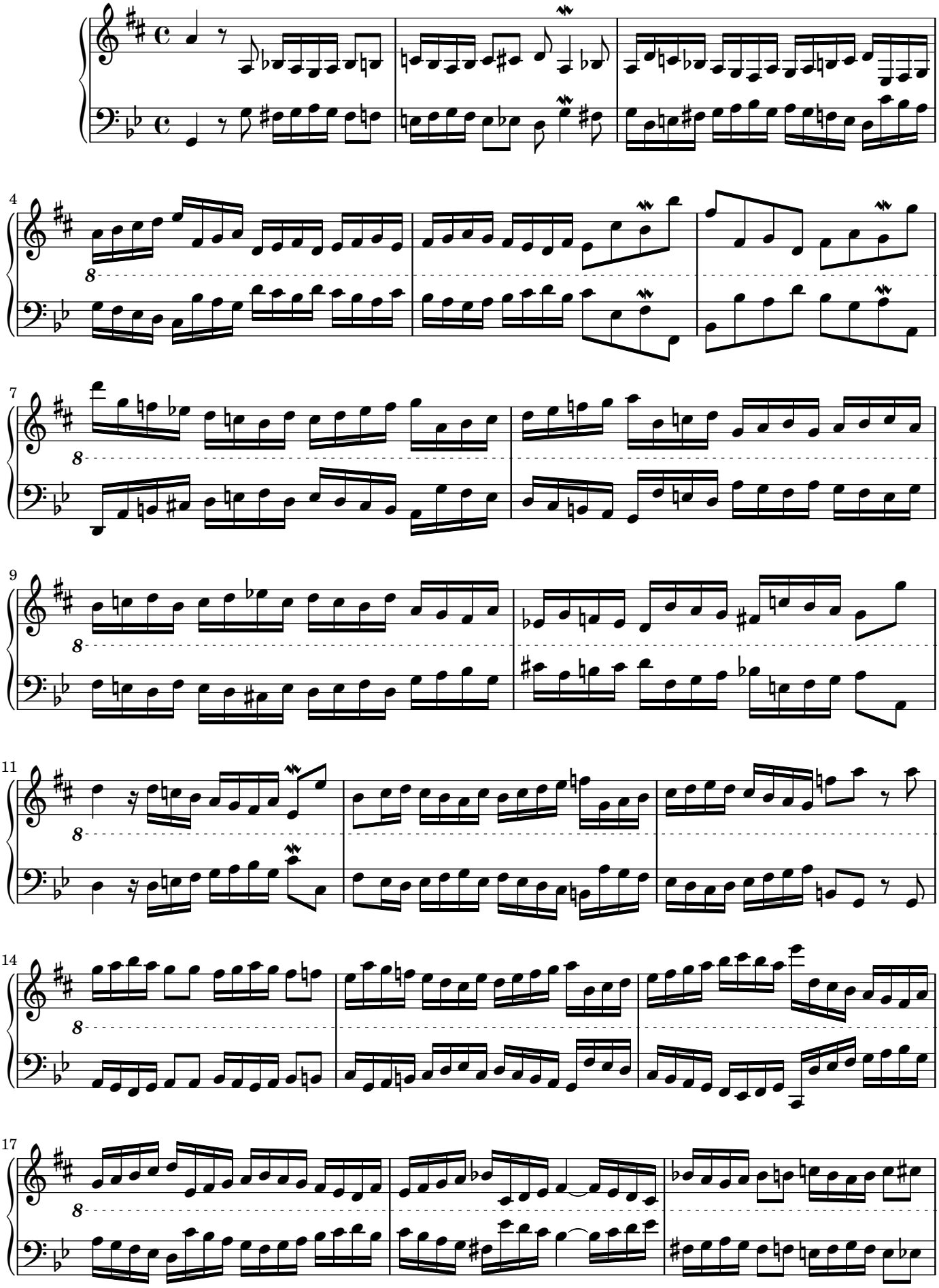
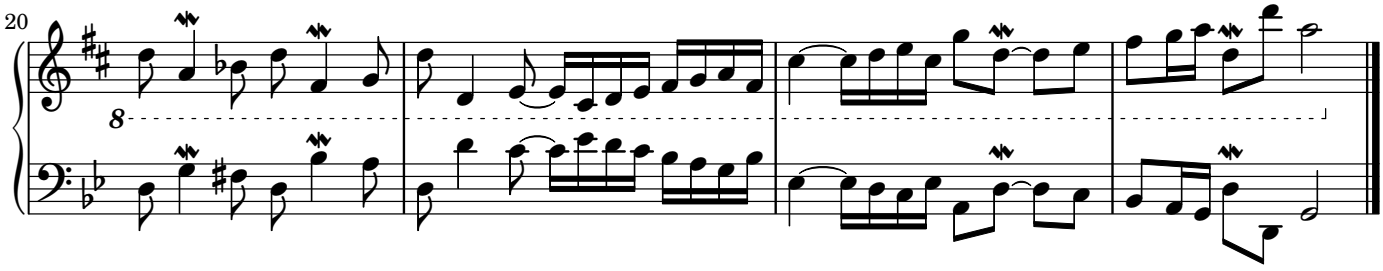
8

Invention 11, BWV 782

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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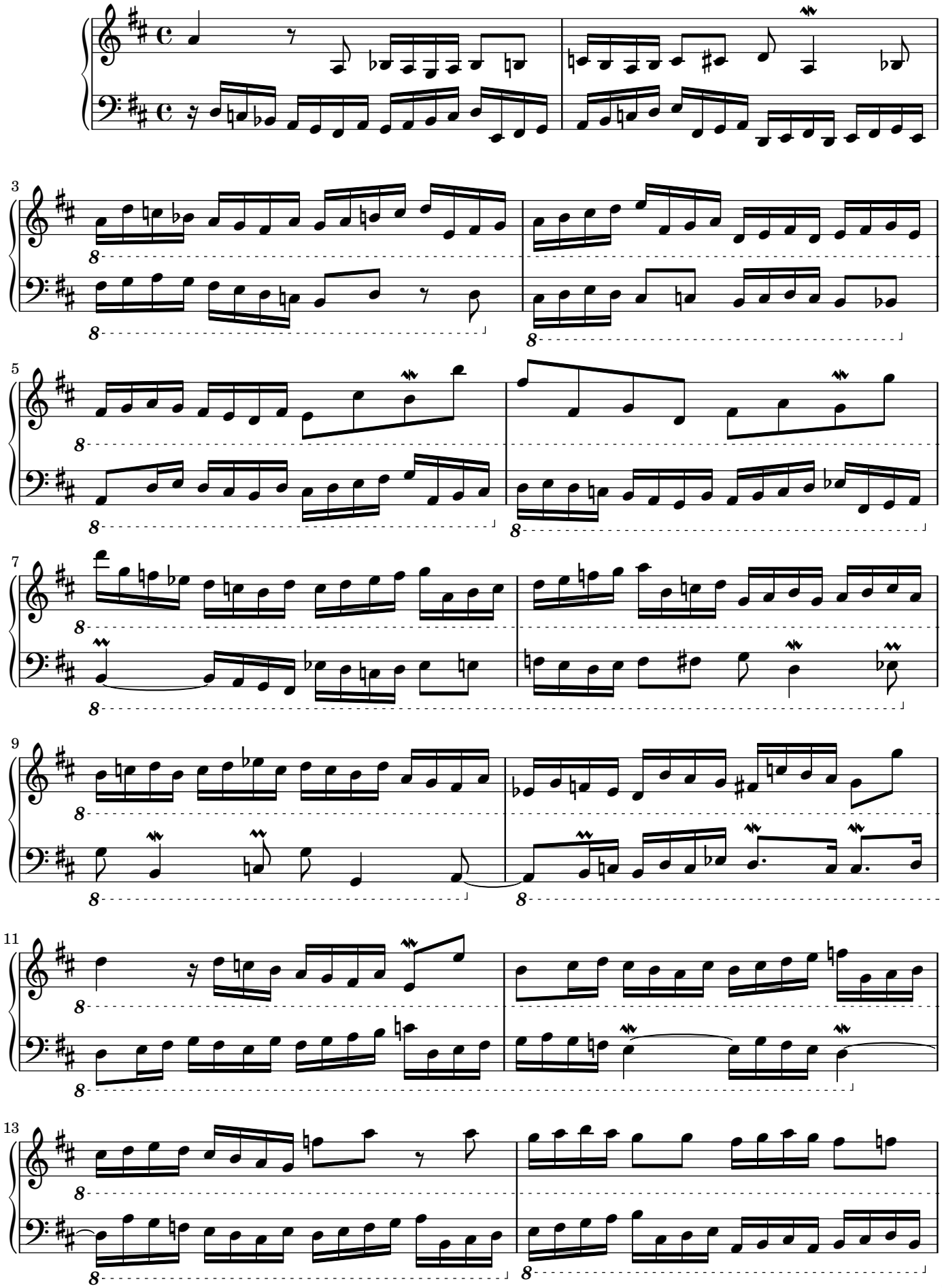
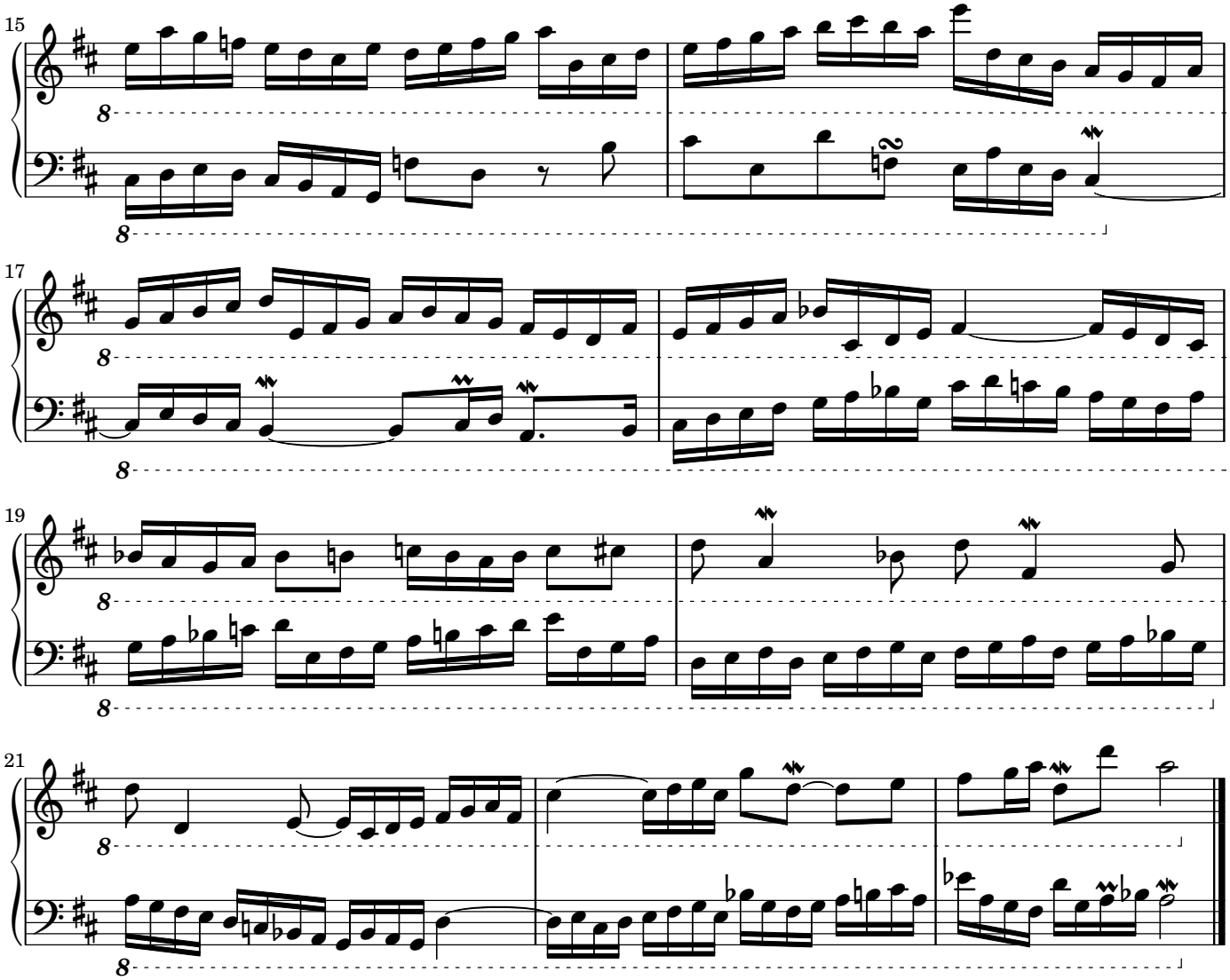
Invention 11, BWV 782

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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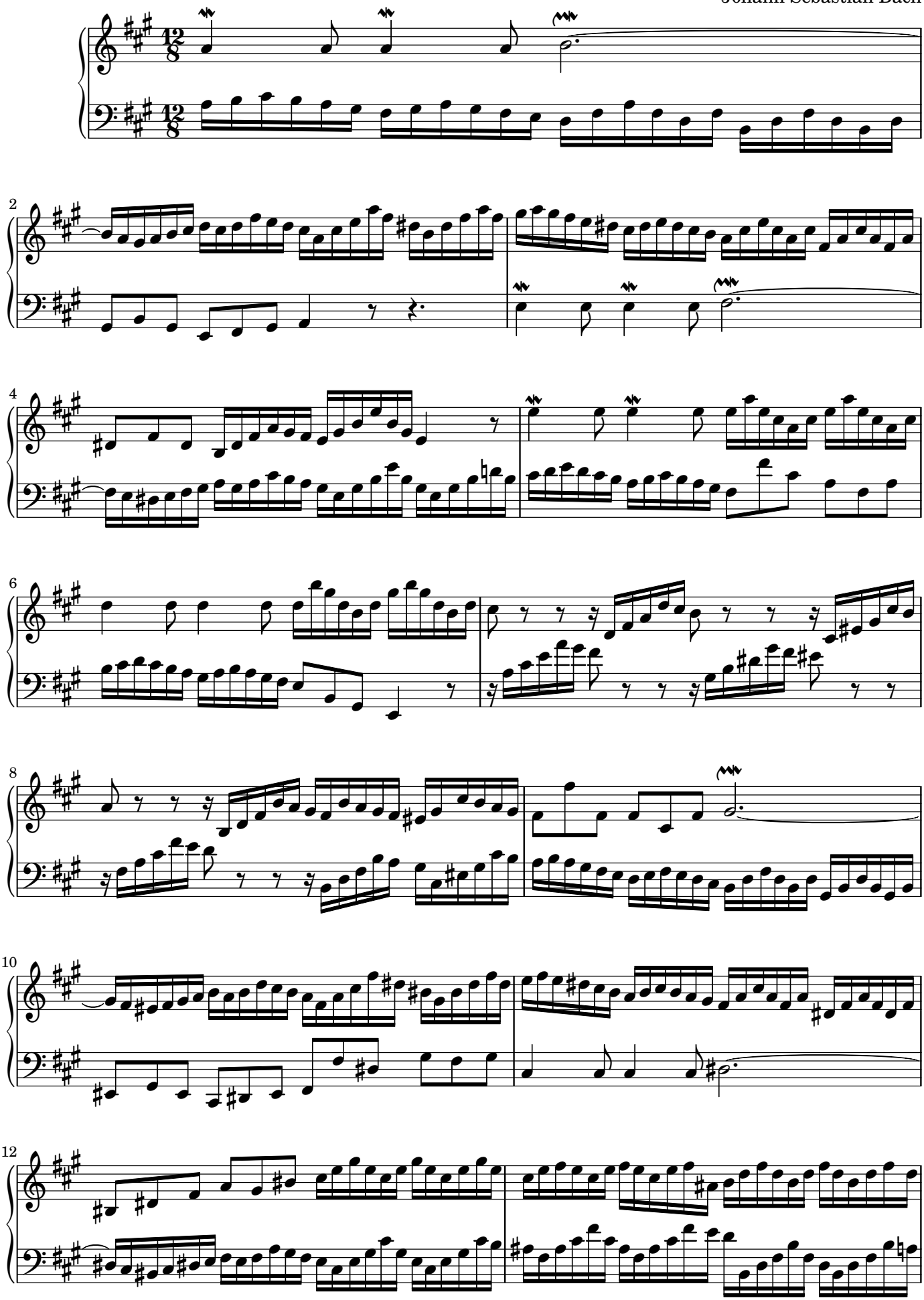
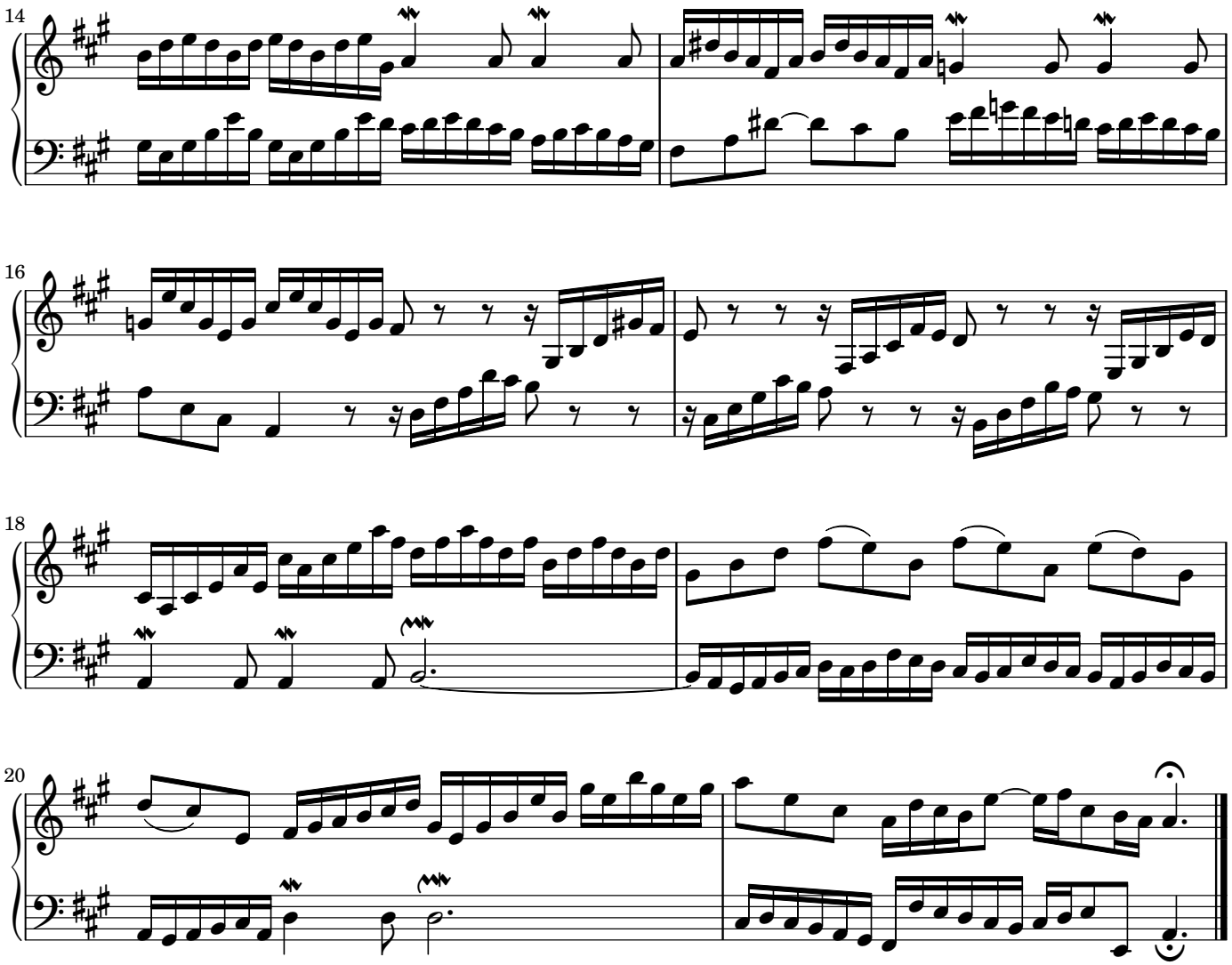
Invention 12, BWV 783

Johann Sebastian Bach




14
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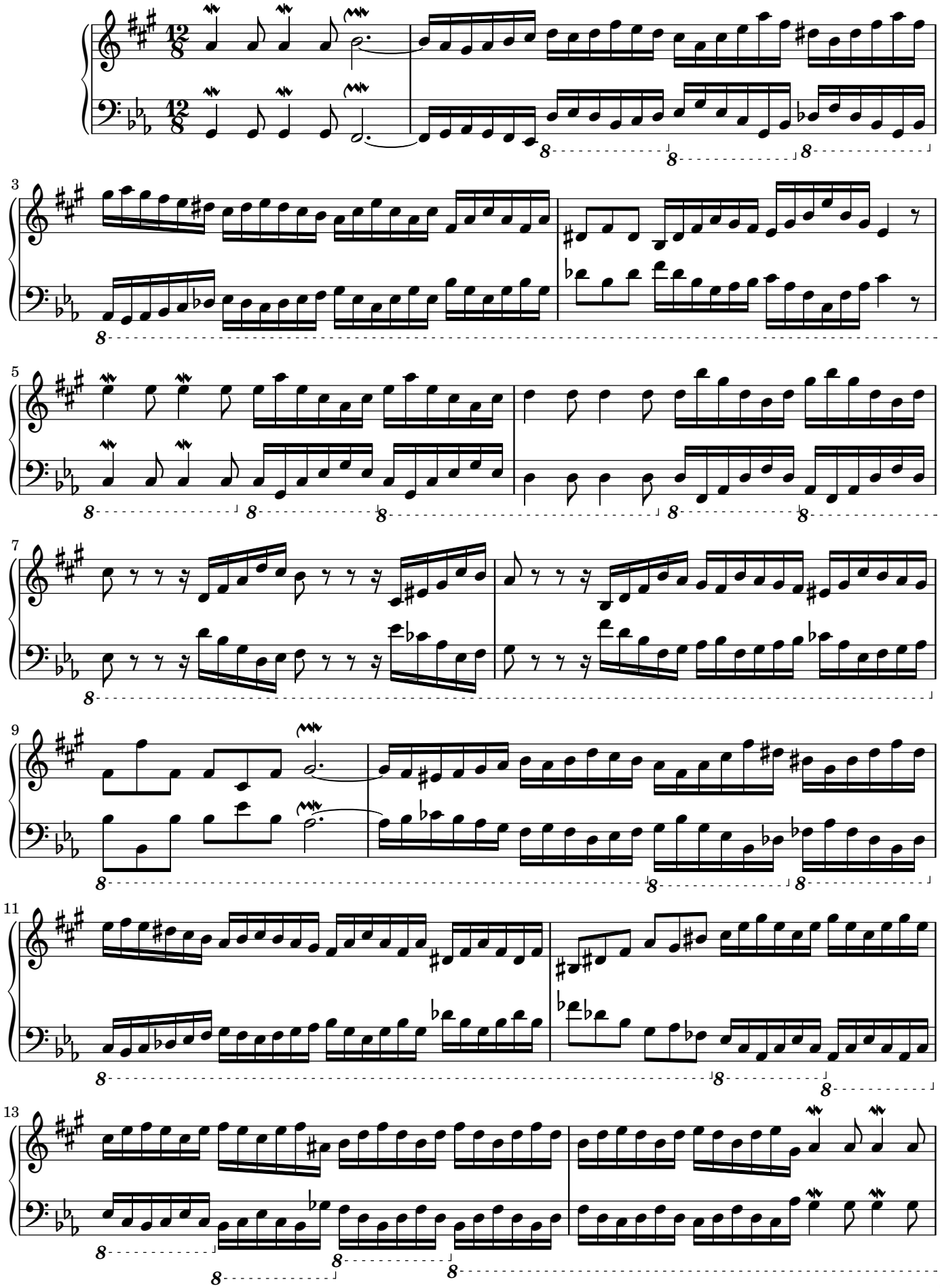
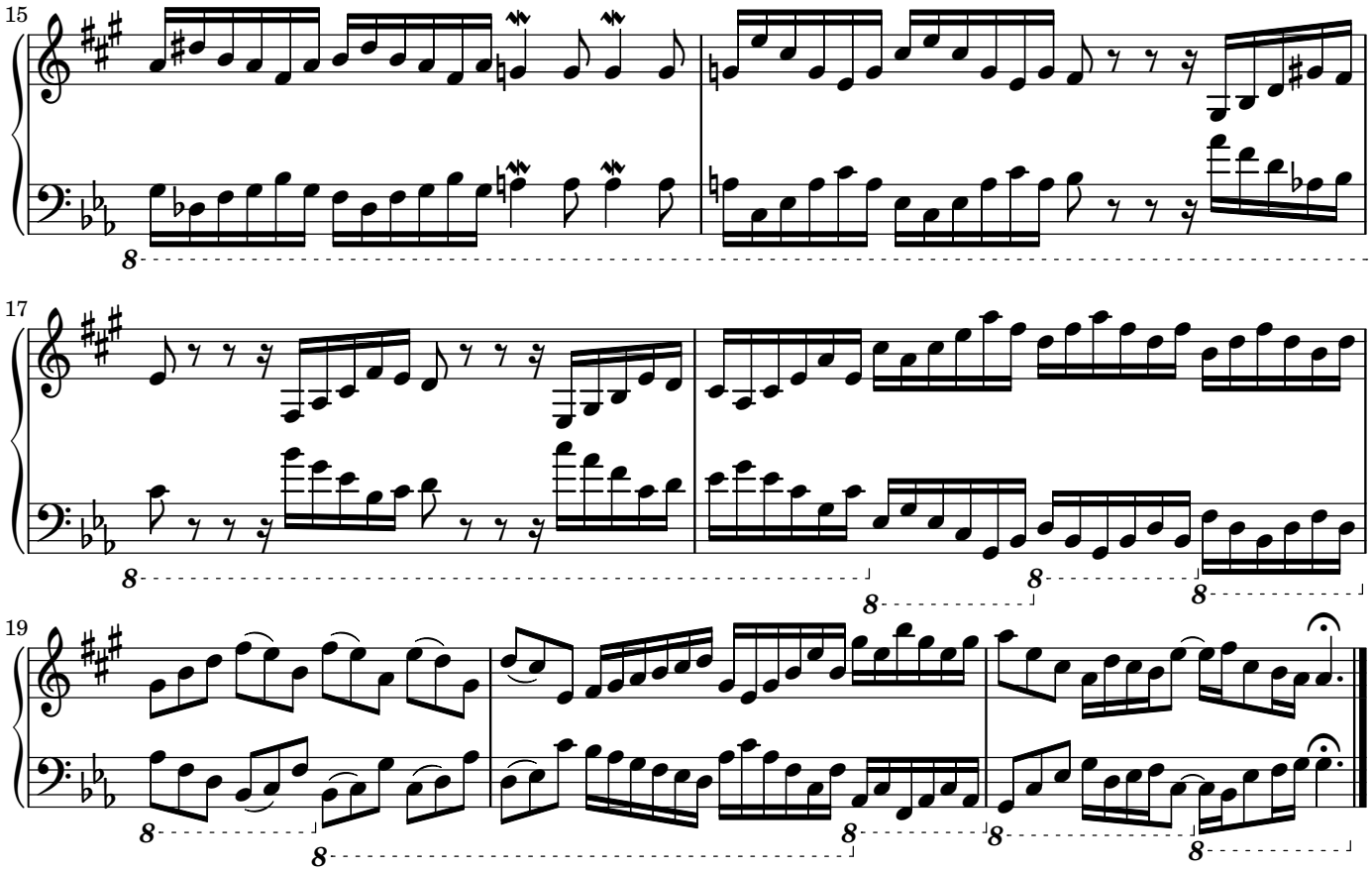
Invention 12, BWV 783

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending




15
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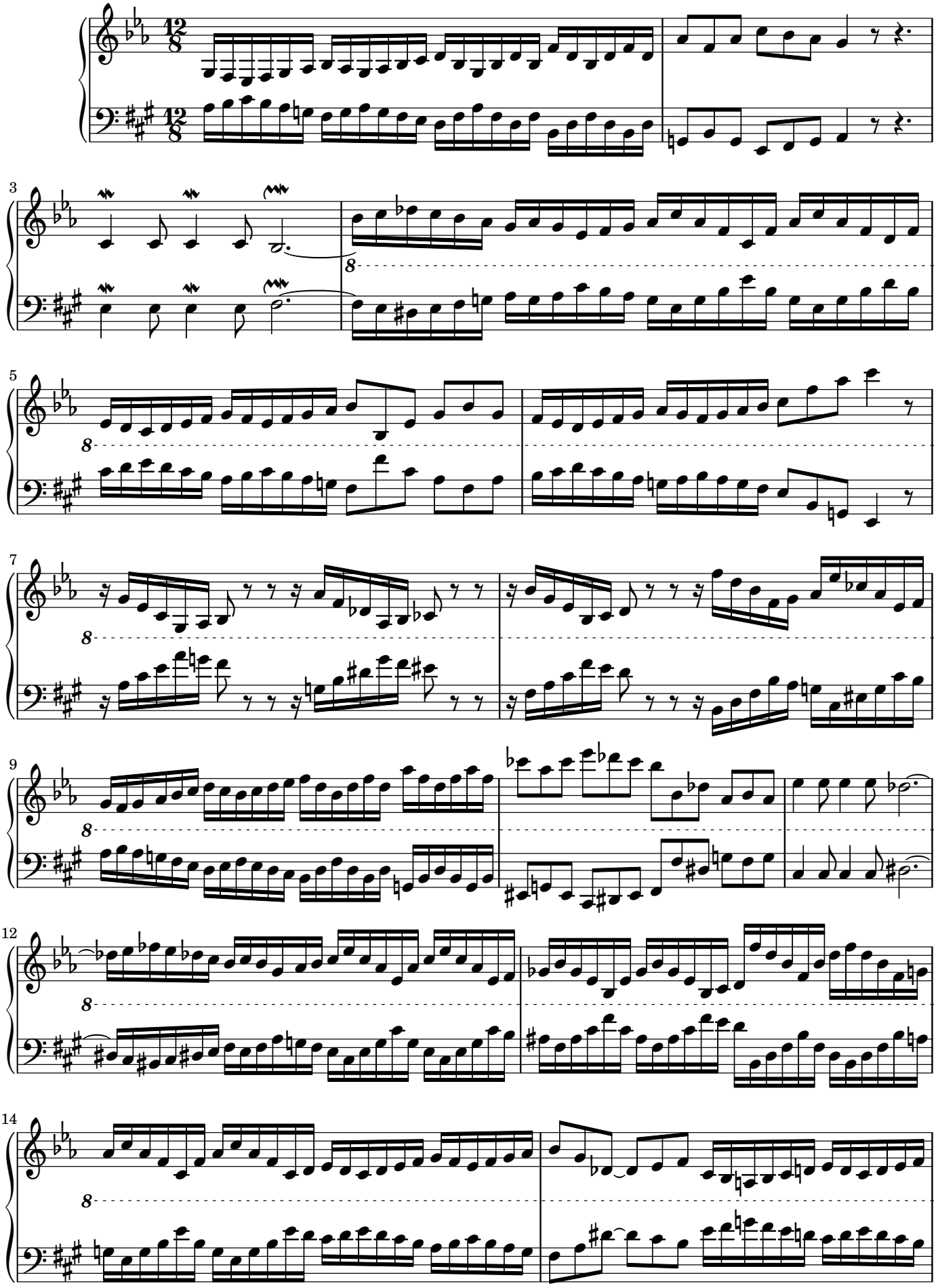
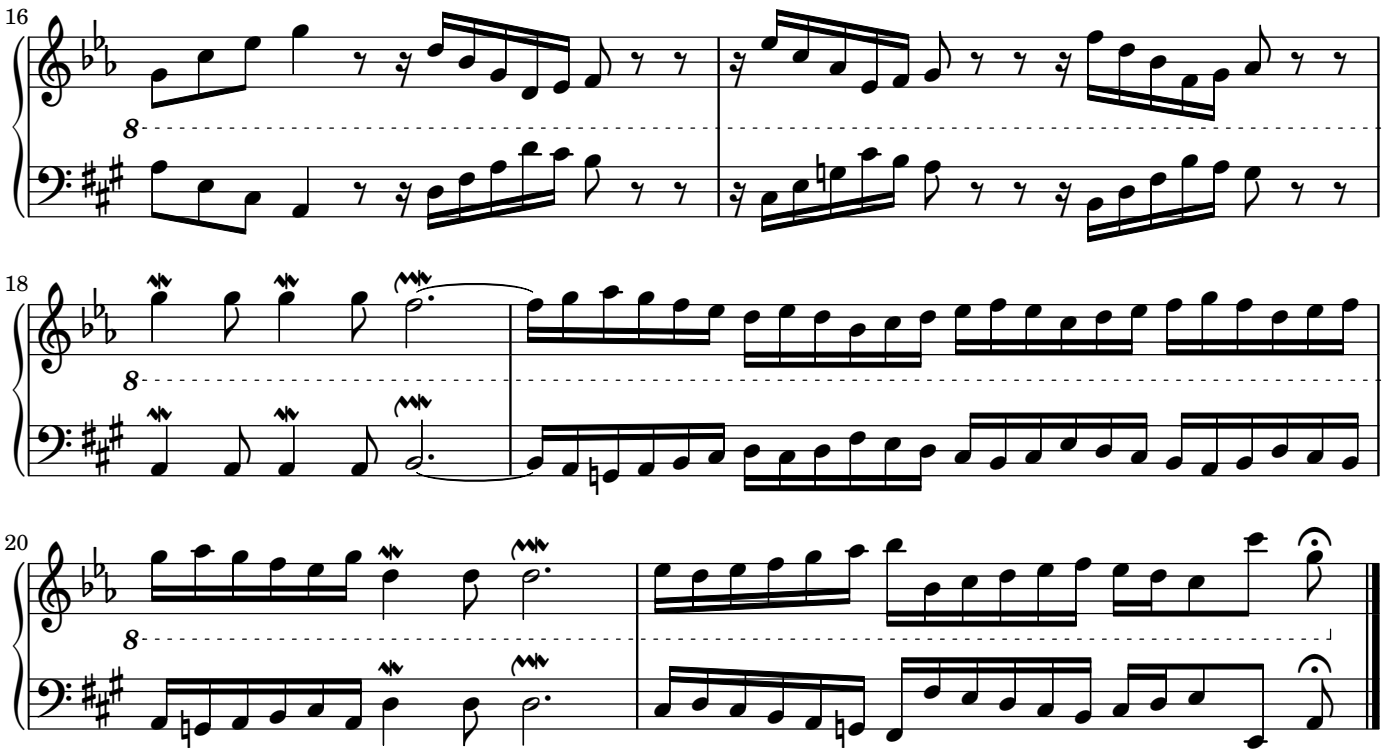
19

Invention 12, BWV 783

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending




16
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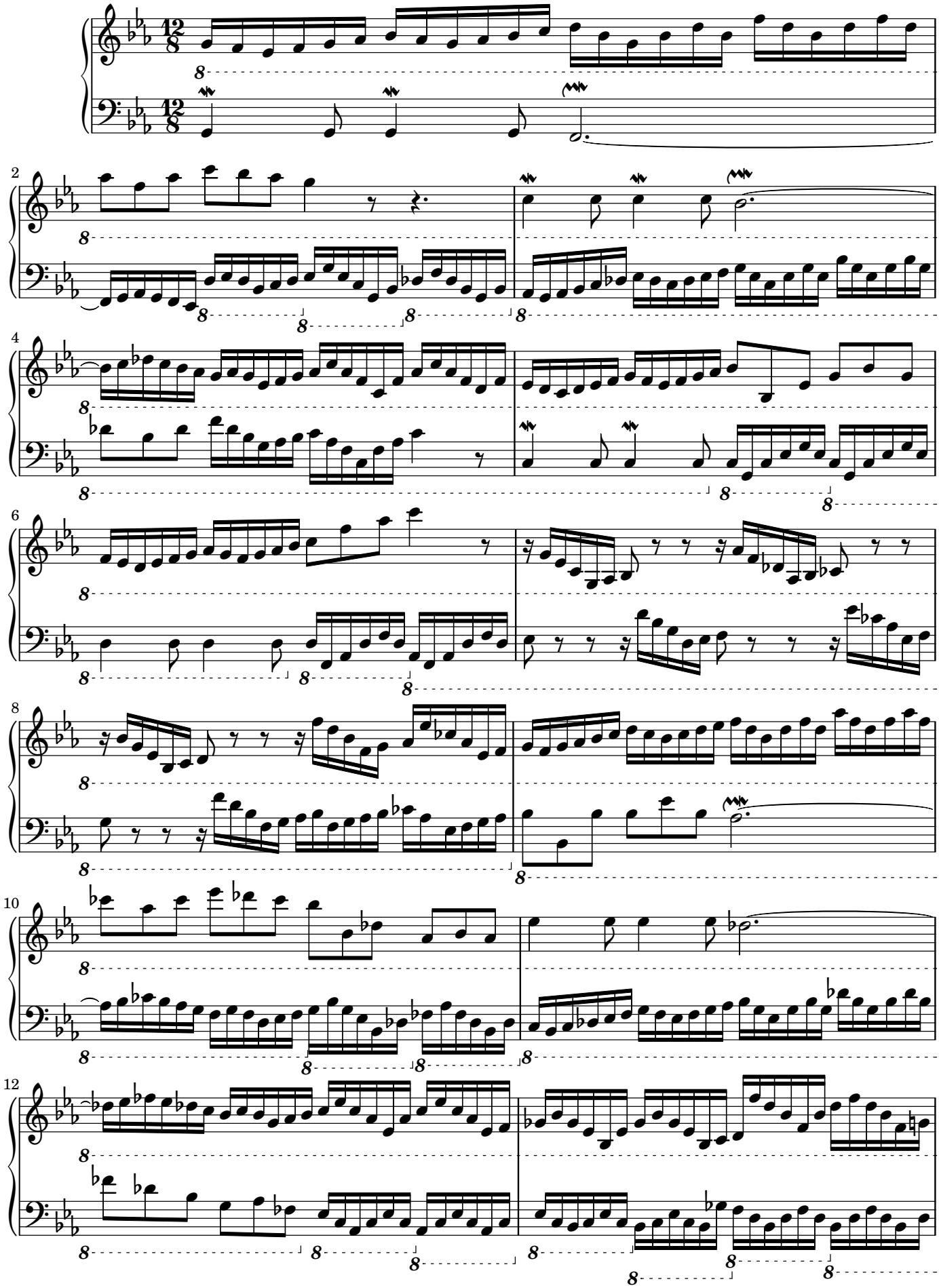
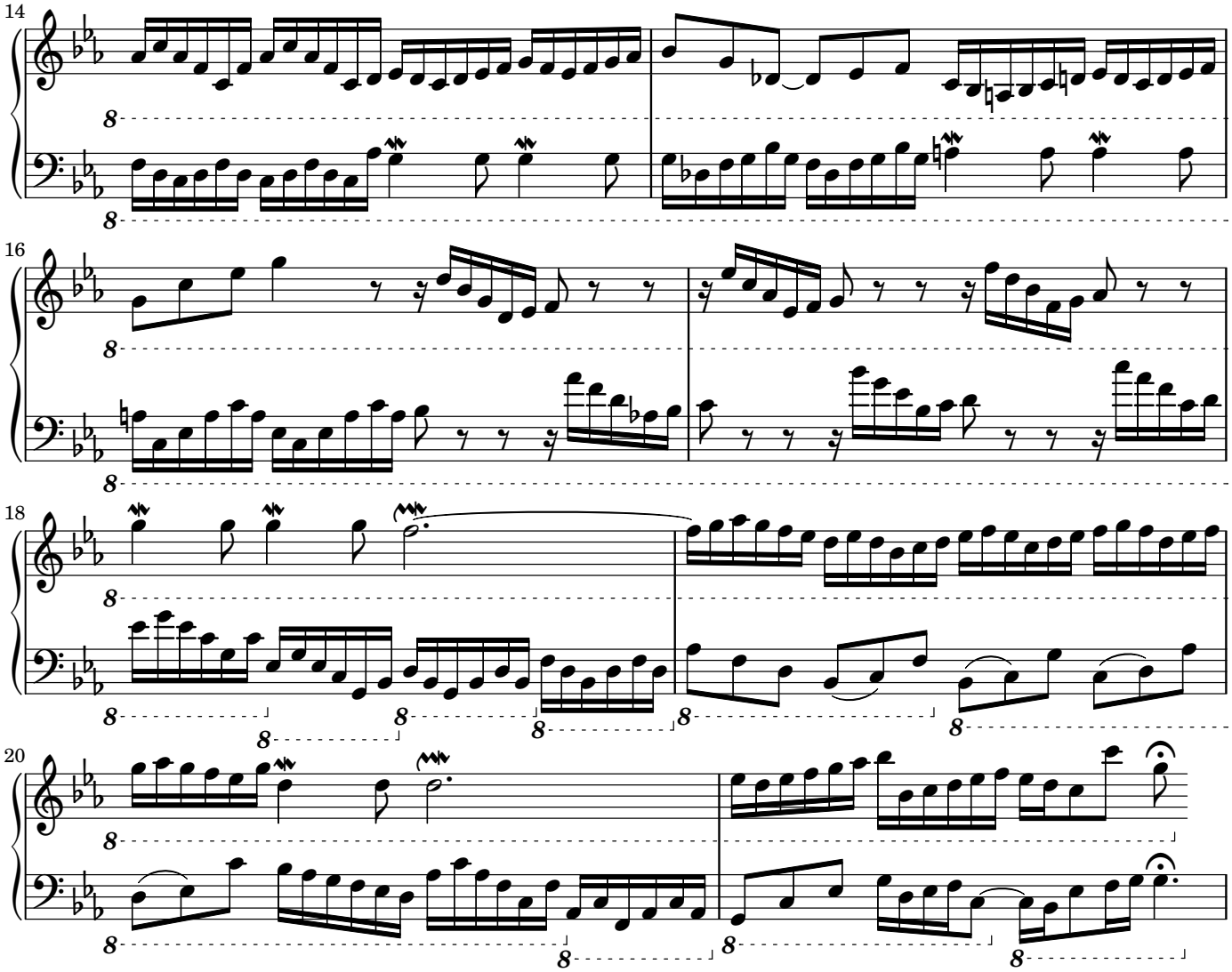
Invention 12, BWV 783

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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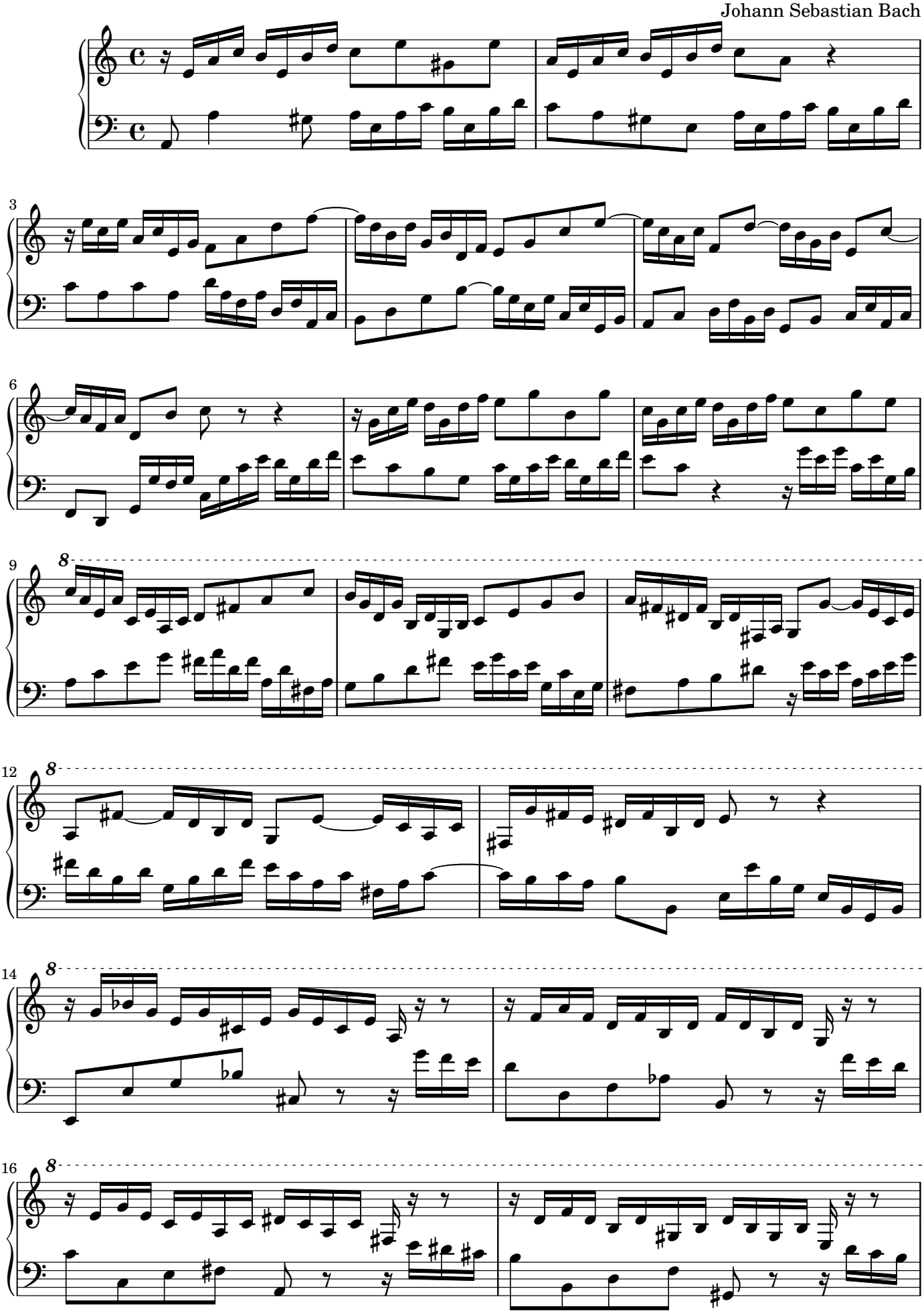
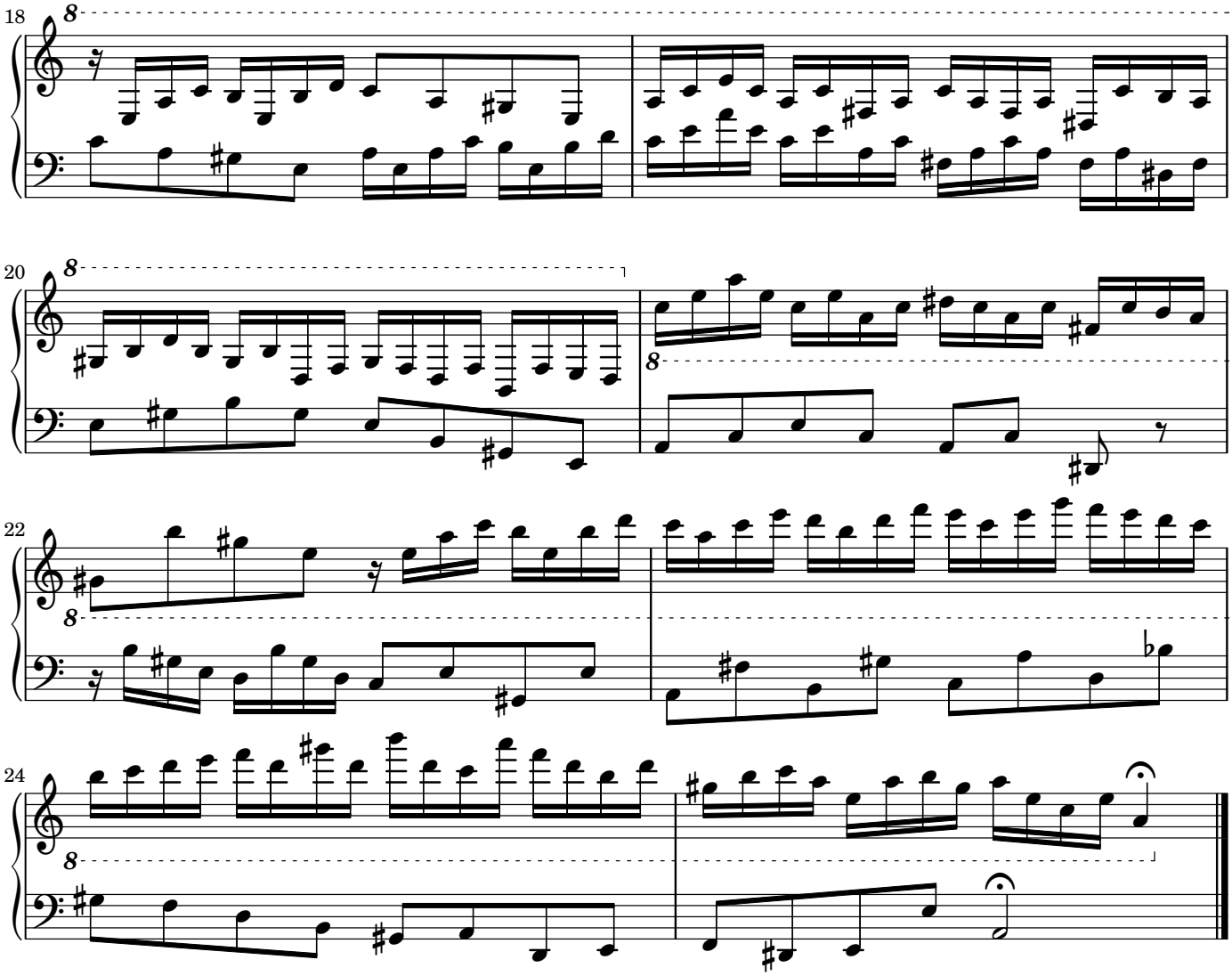
Invention 13, BWV 784

Johann Sebastian Bach

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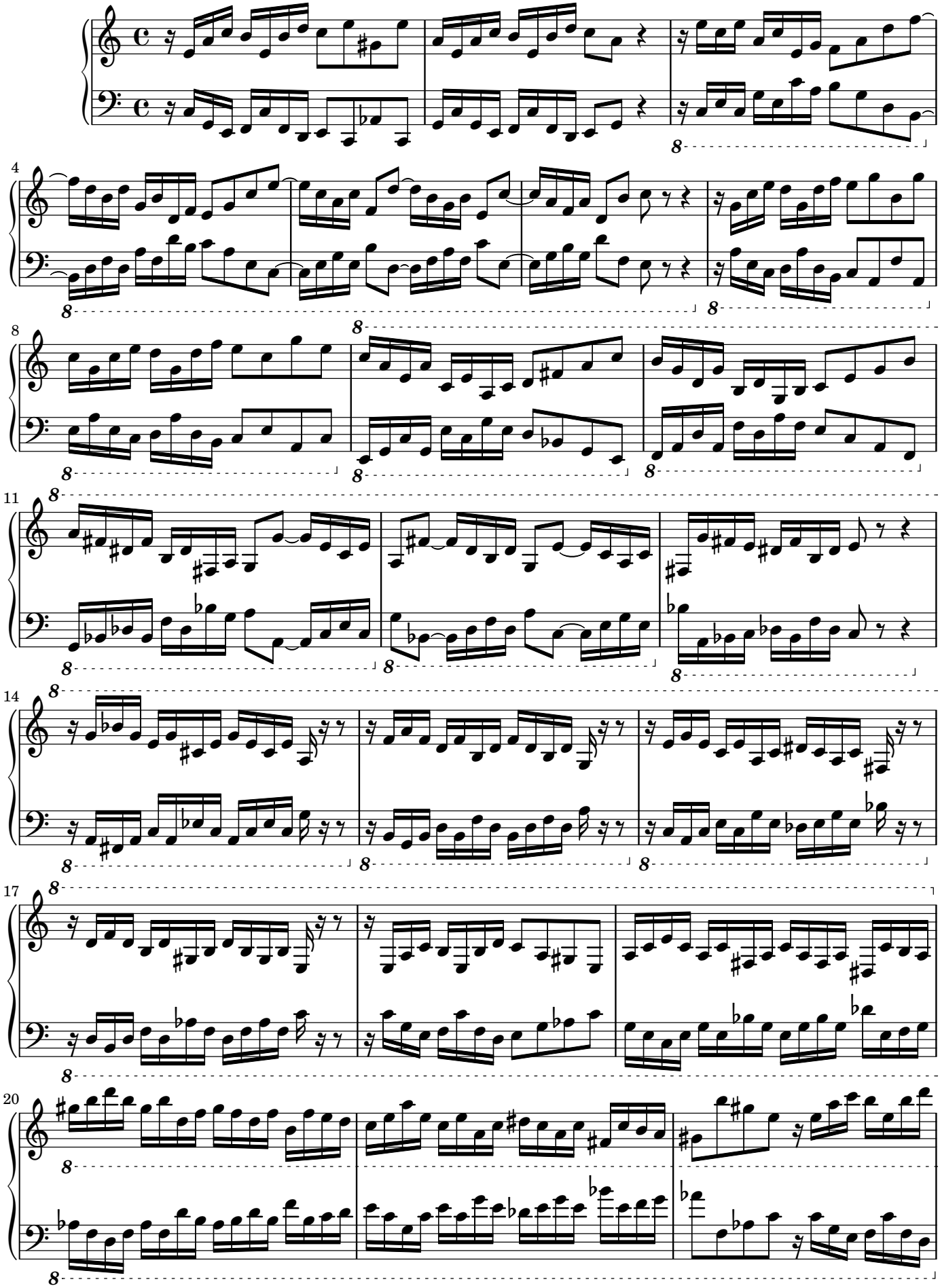
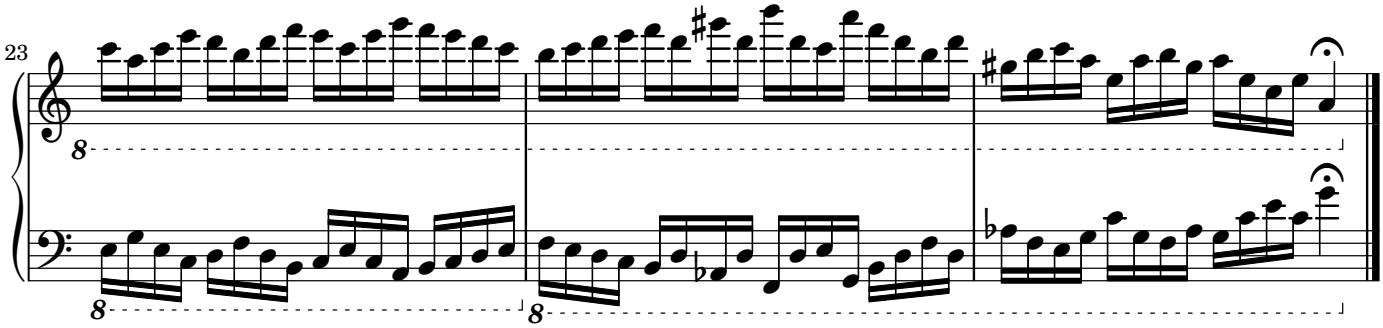
Invention 13, BWV 784

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

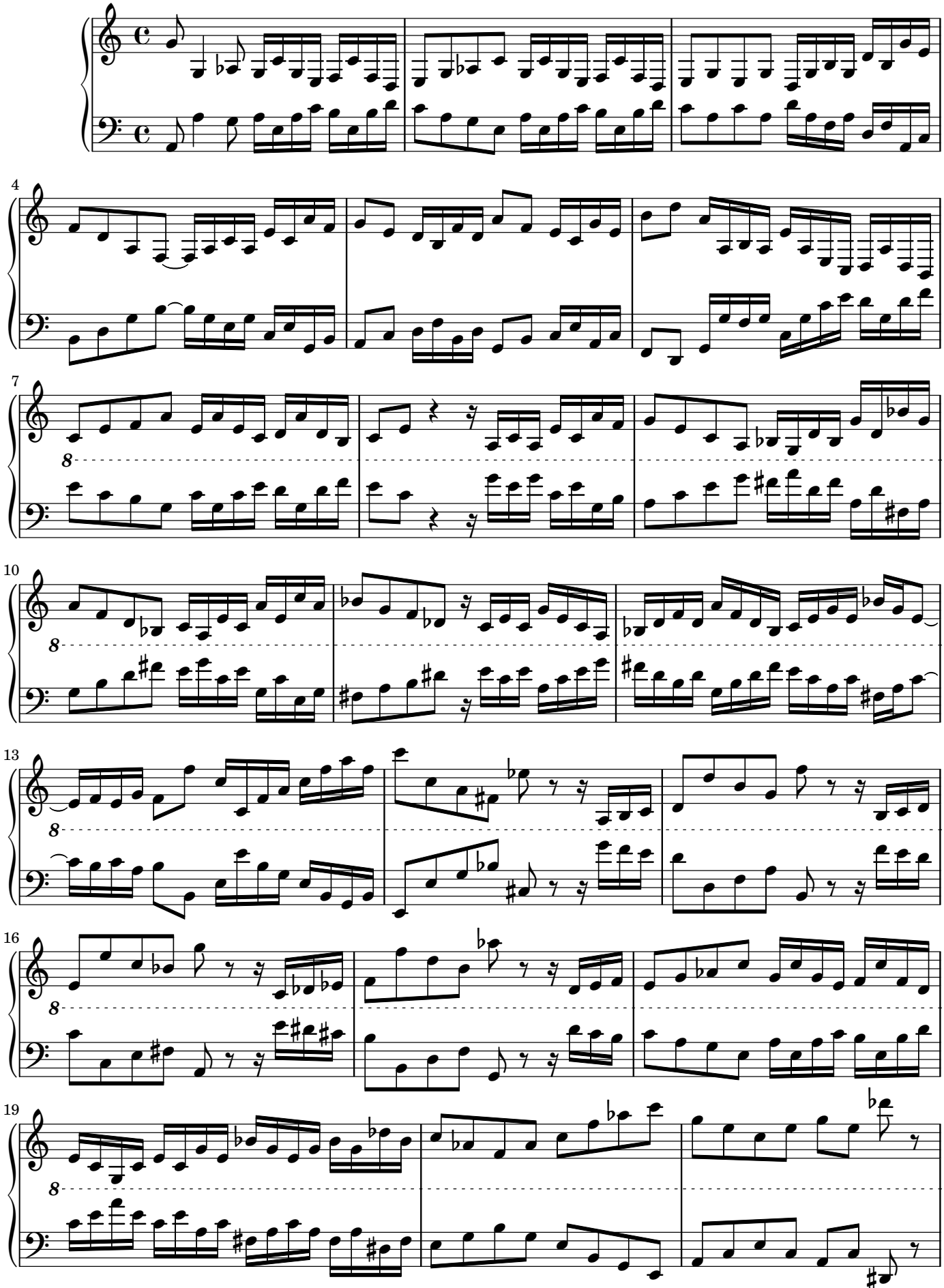


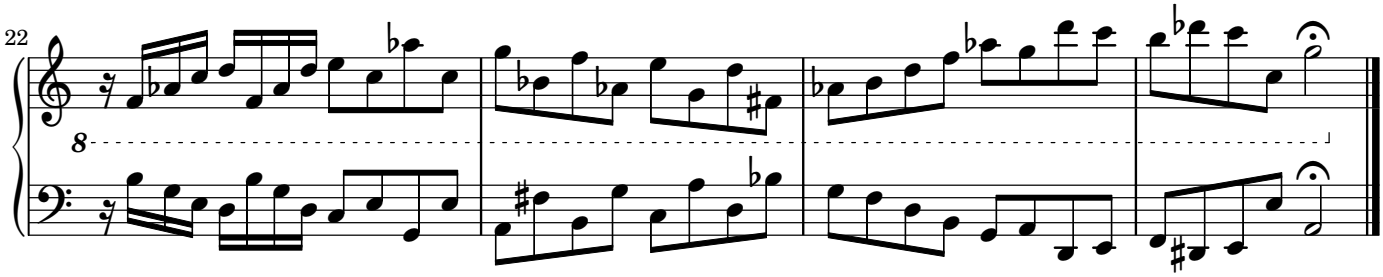

23

Invention 13, BWV 784

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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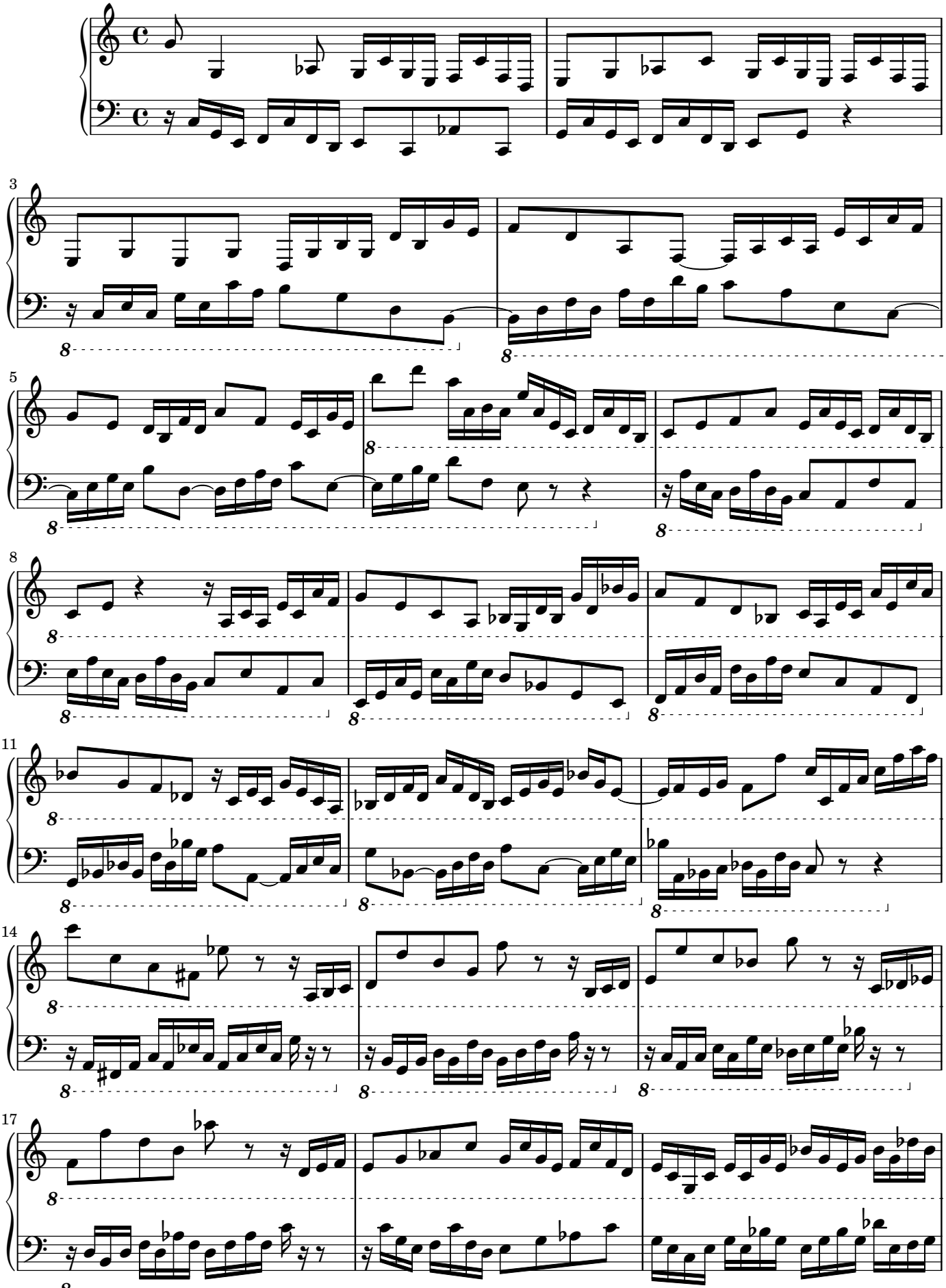
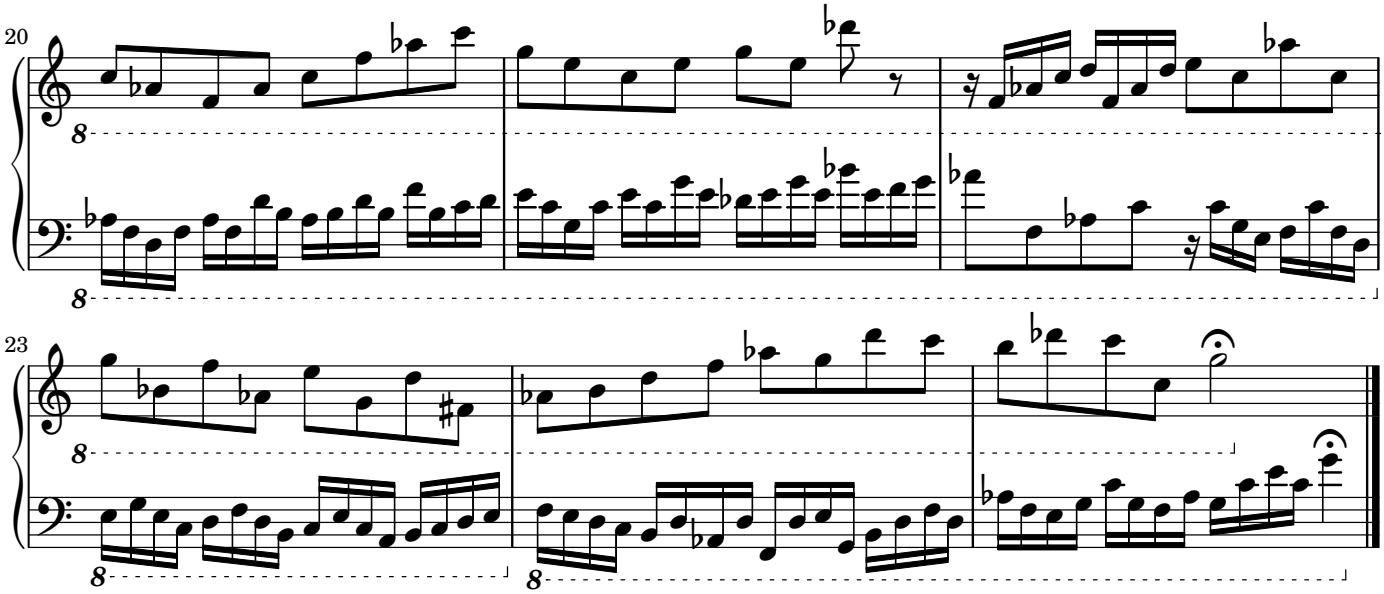
8

Invention 13, BWV 784

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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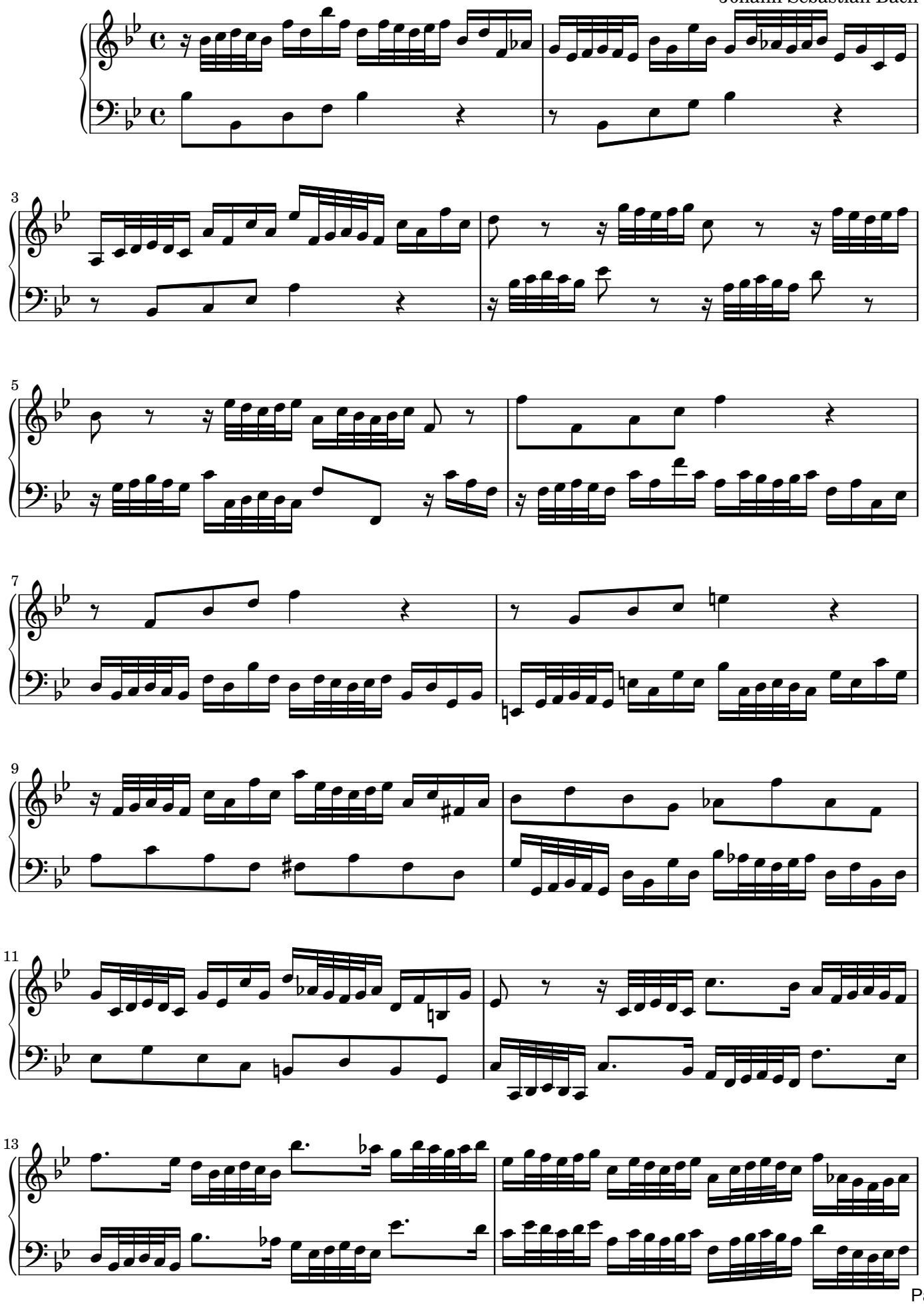
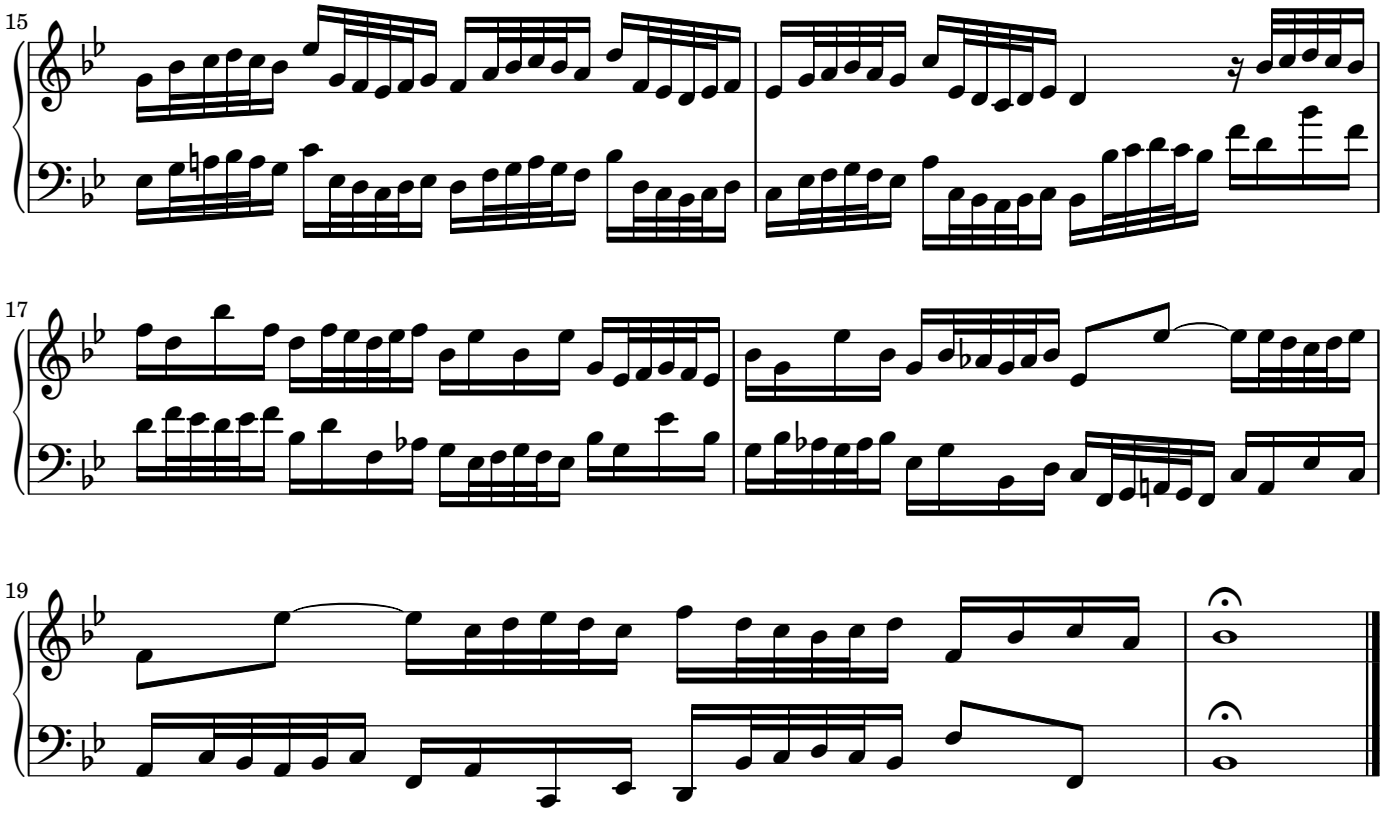
Invention 14, BWV 785

Johann Sebastian Bach

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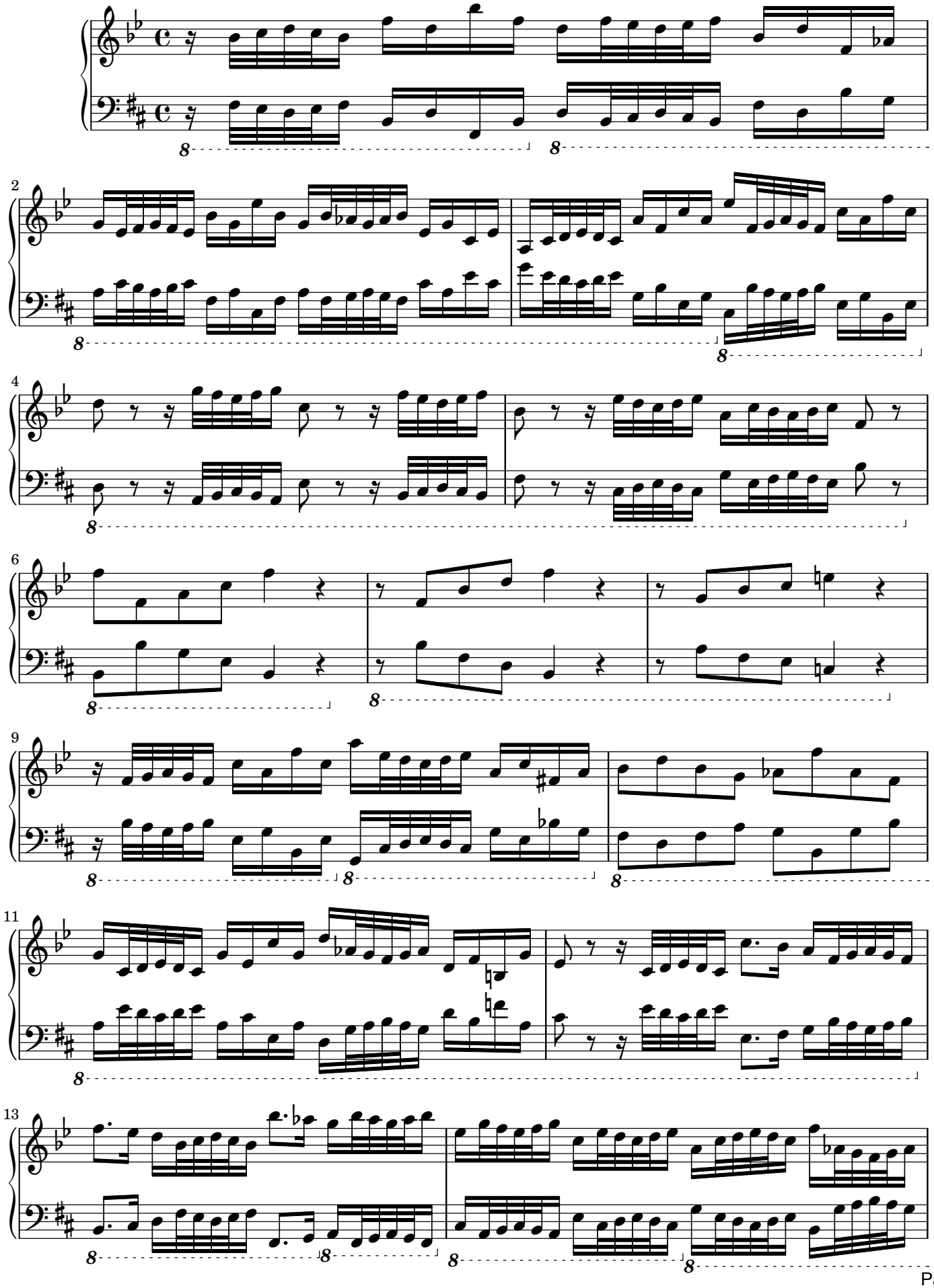
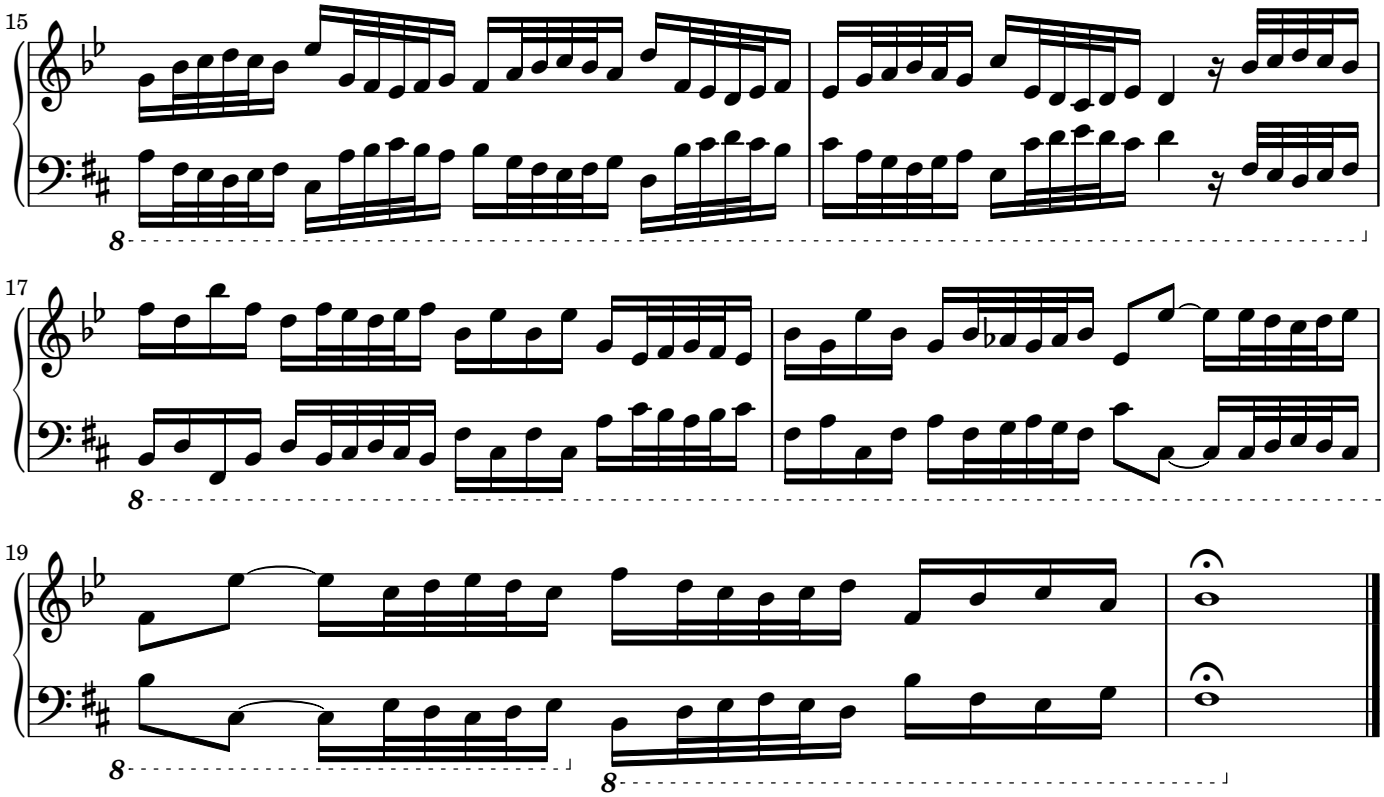
Invention 14, BWV 785

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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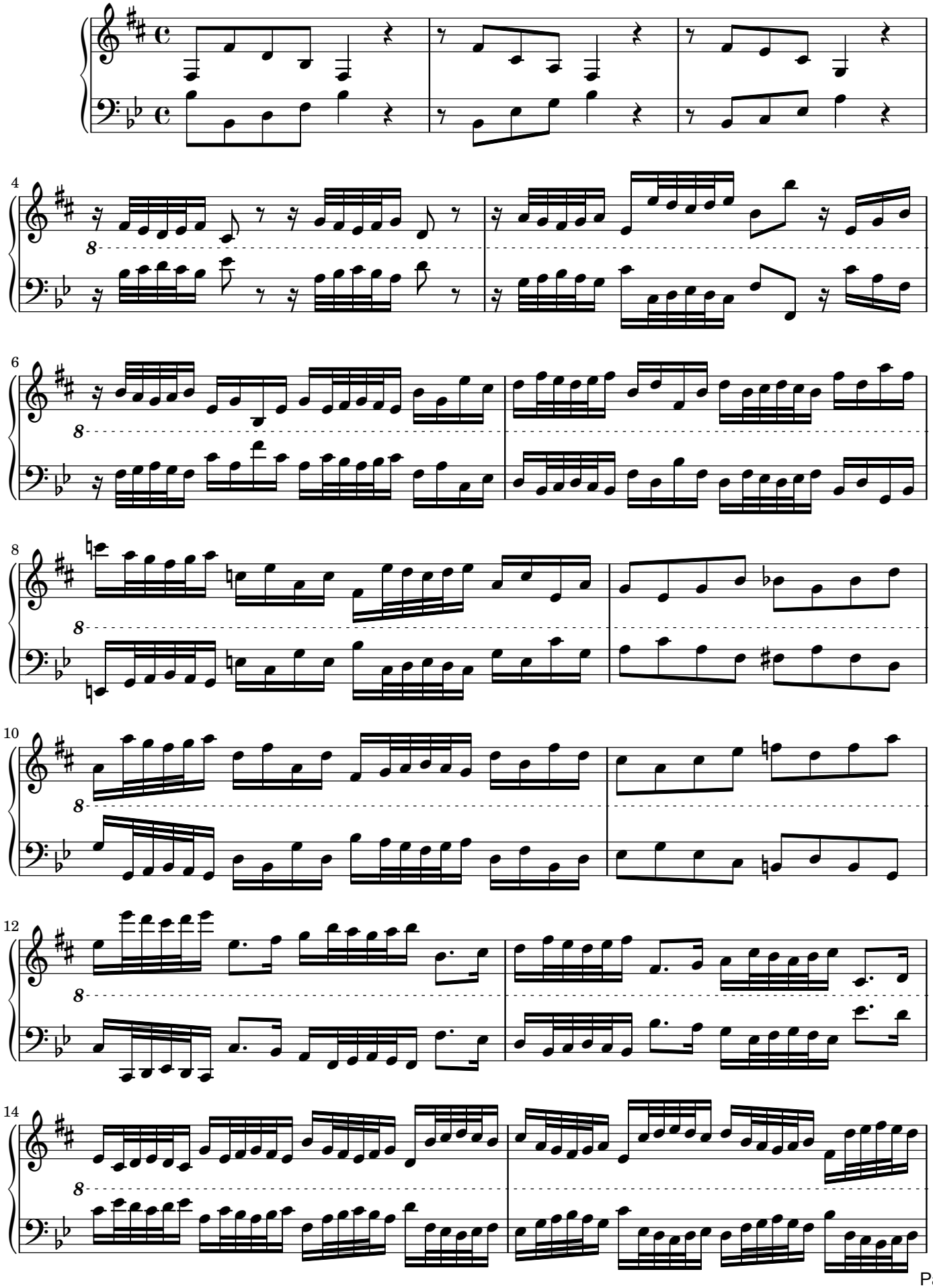
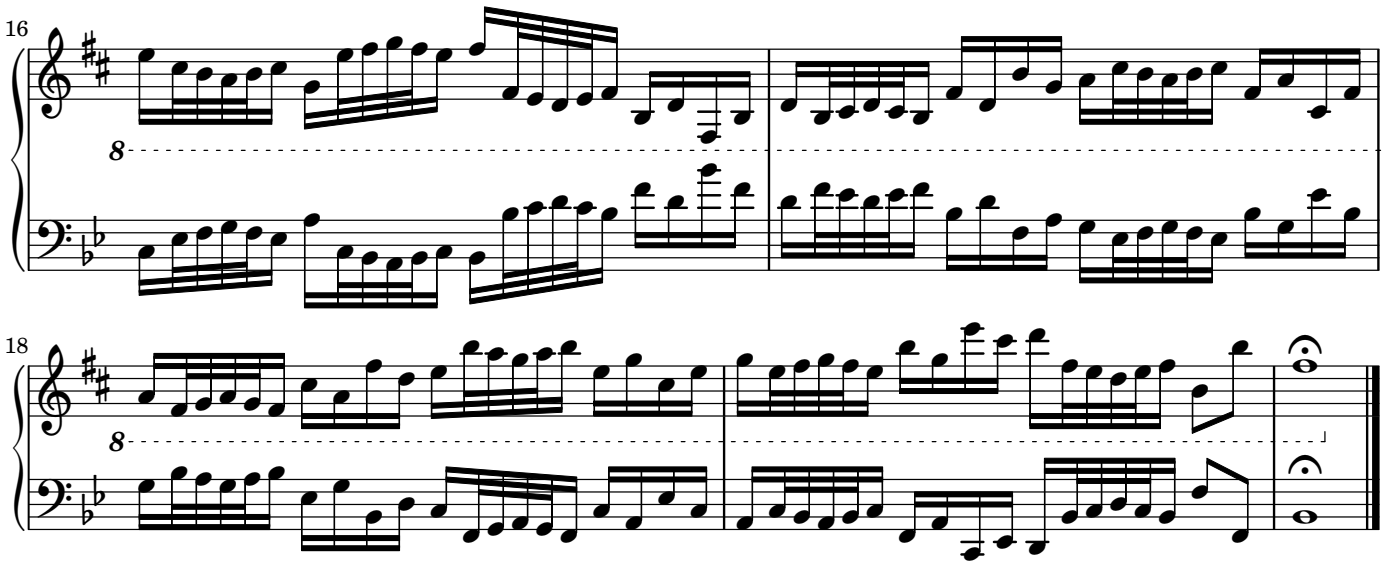
Invention 14, BWV 785

Benjamin Pritchard, after Johann Sebastian Bach

Right Hand Descending

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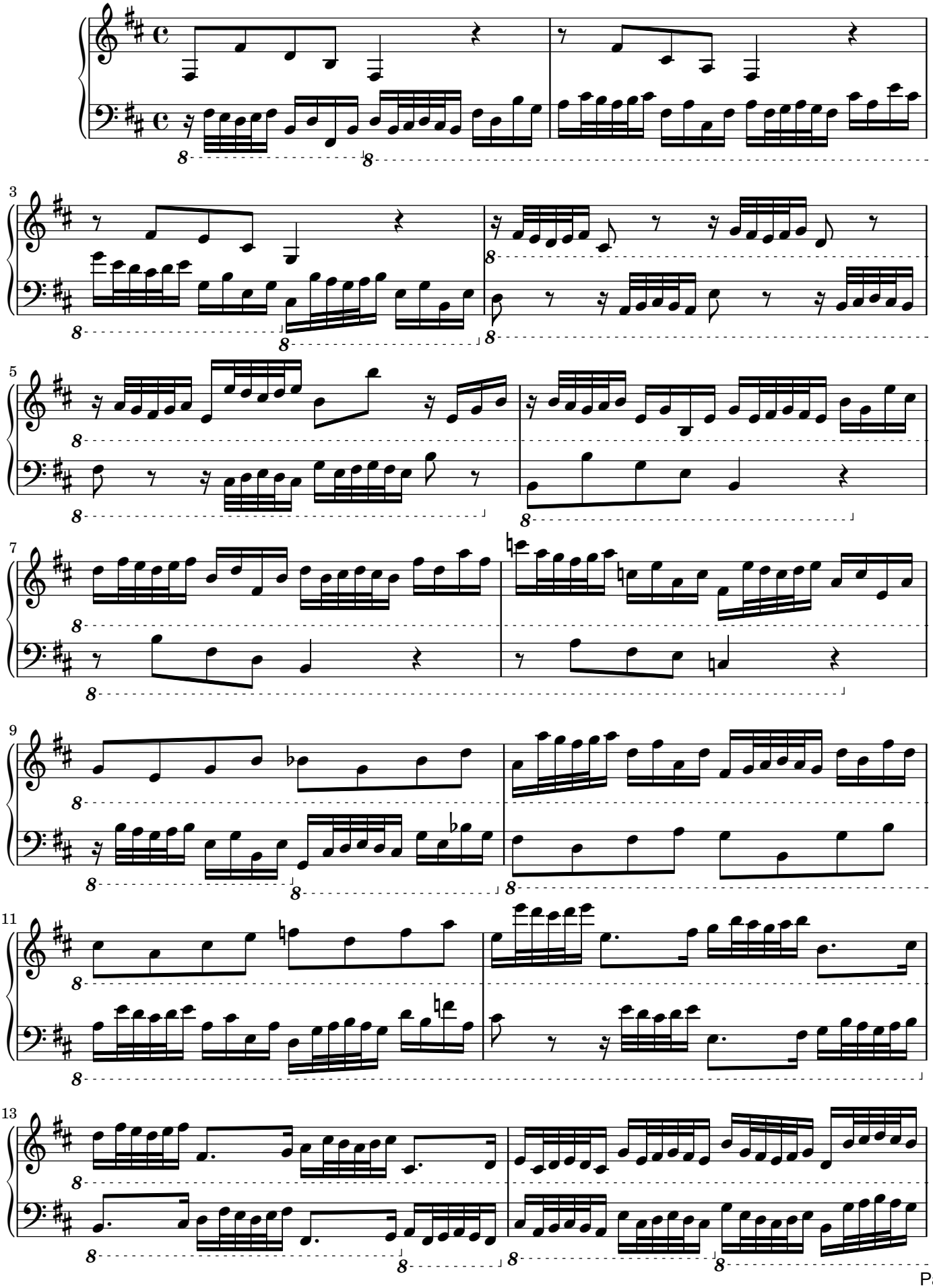
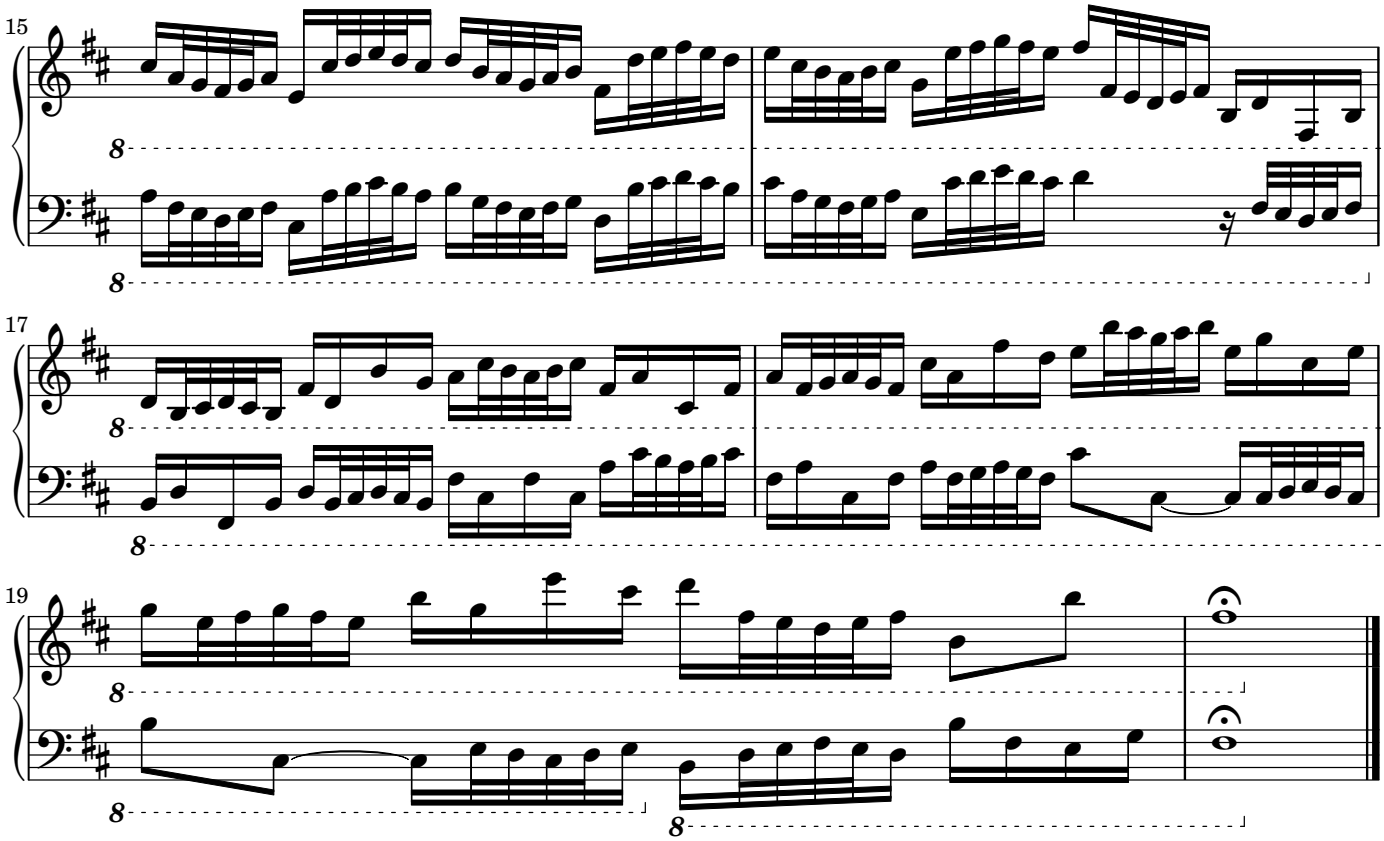
Invention 14, BWV 785

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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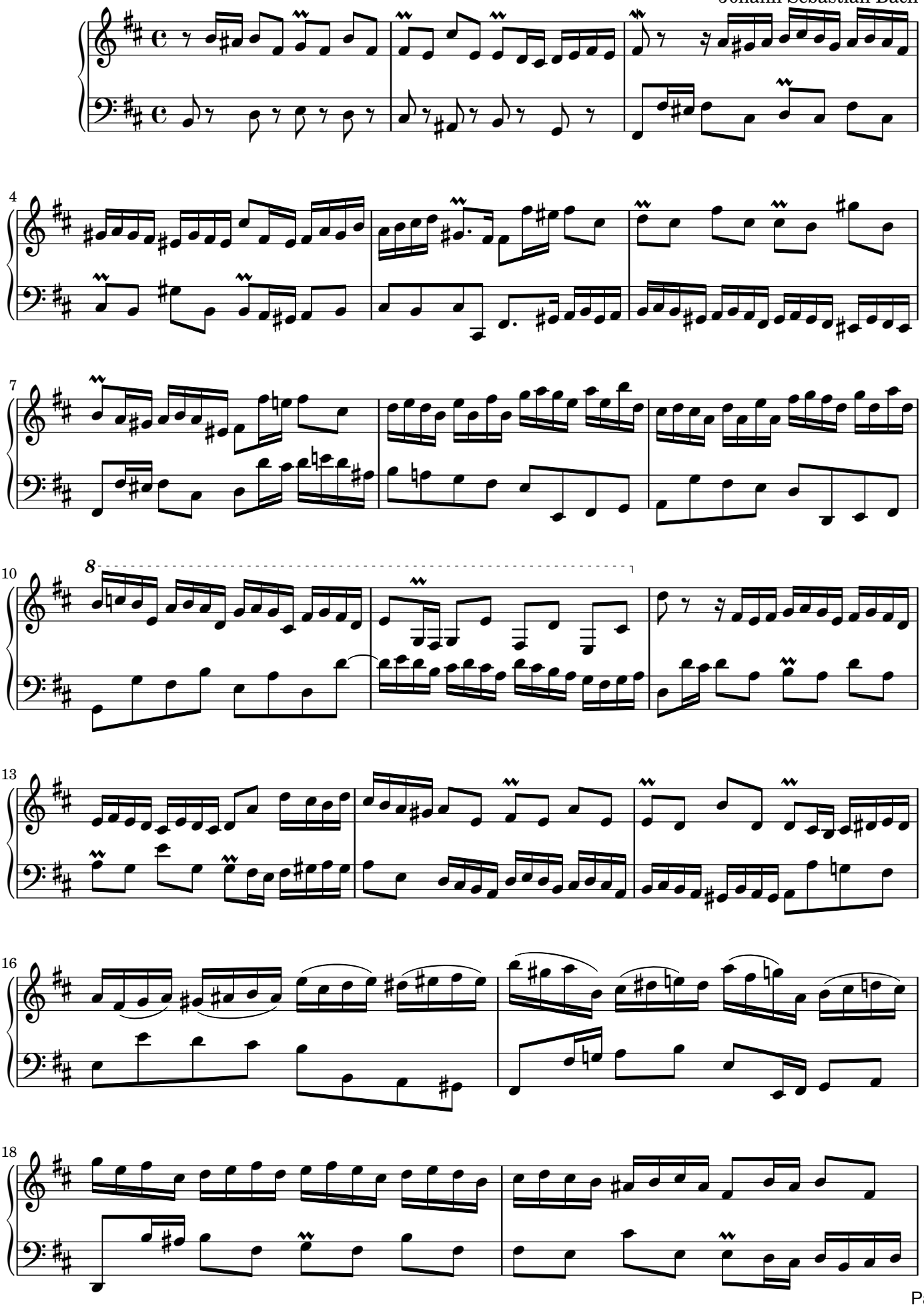
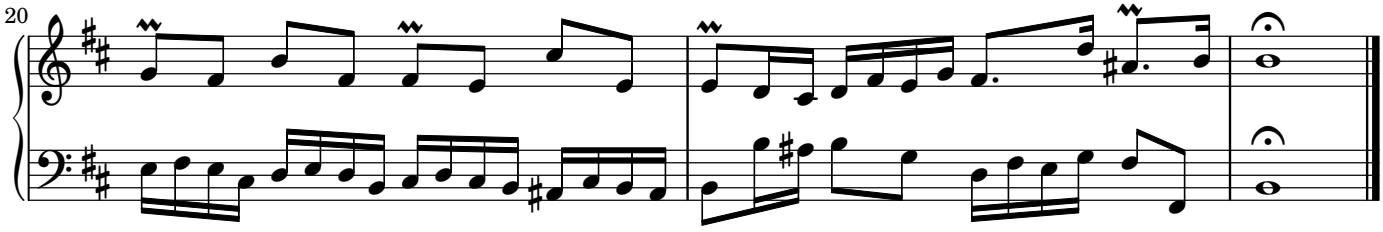
Invention 15, BWV 786

Johann Sebastian Bach

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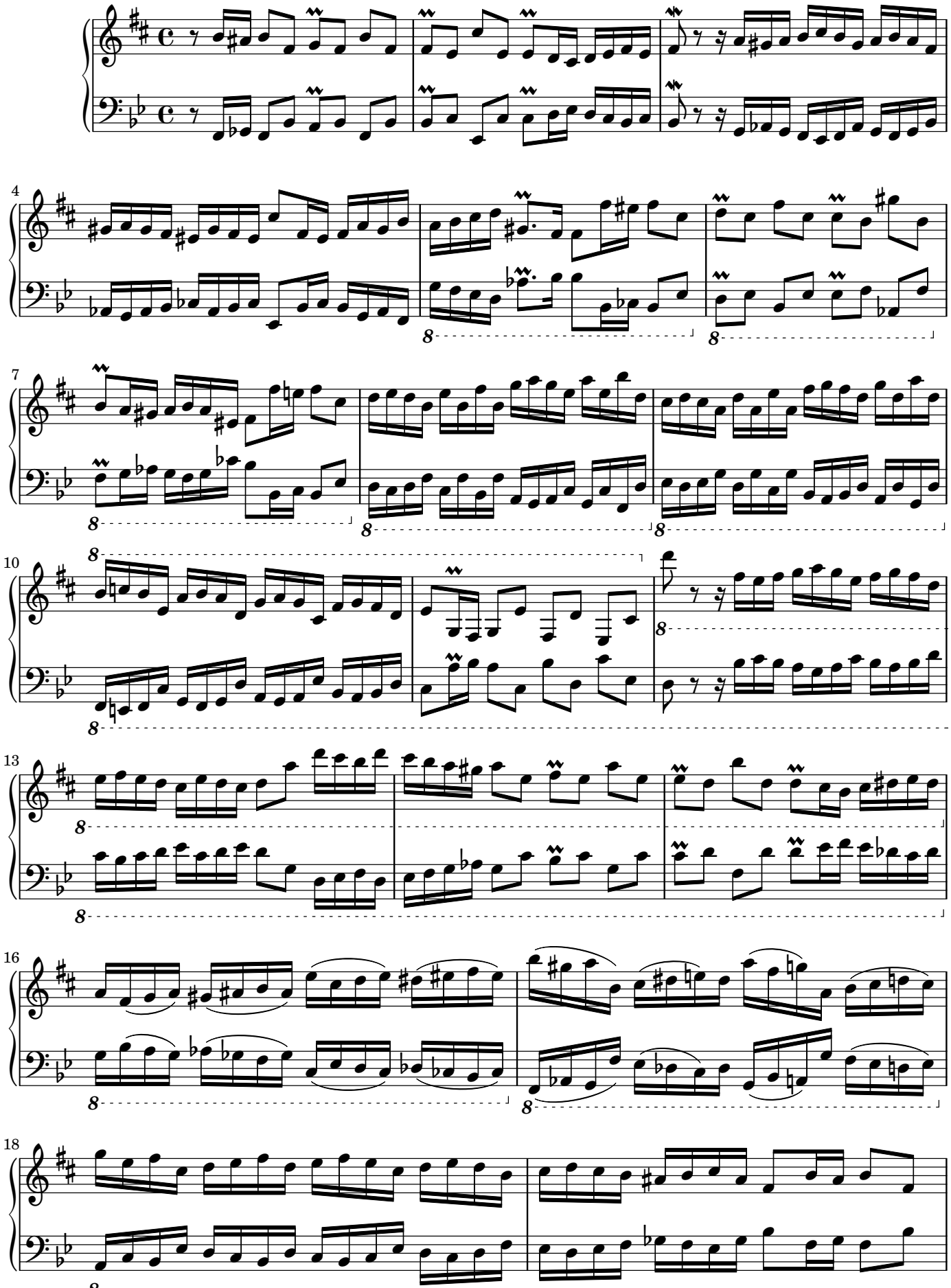
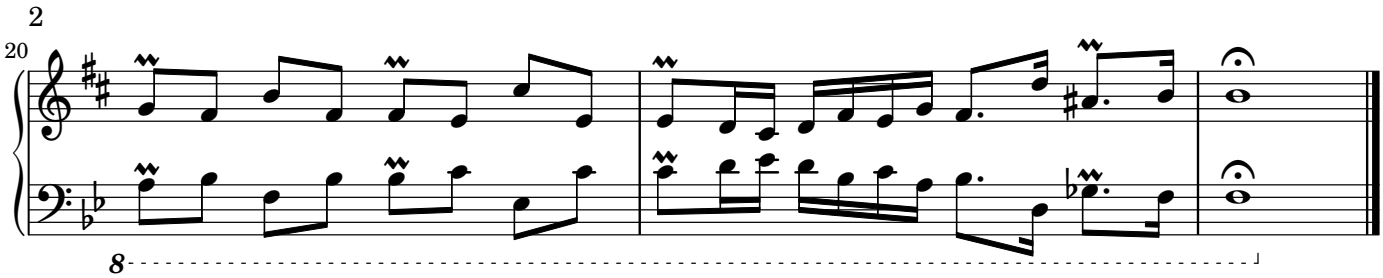
Invention 15, BWV 786

Benjamin Pritchard, after Johann Sebastian Bach

Left Hand Ascending

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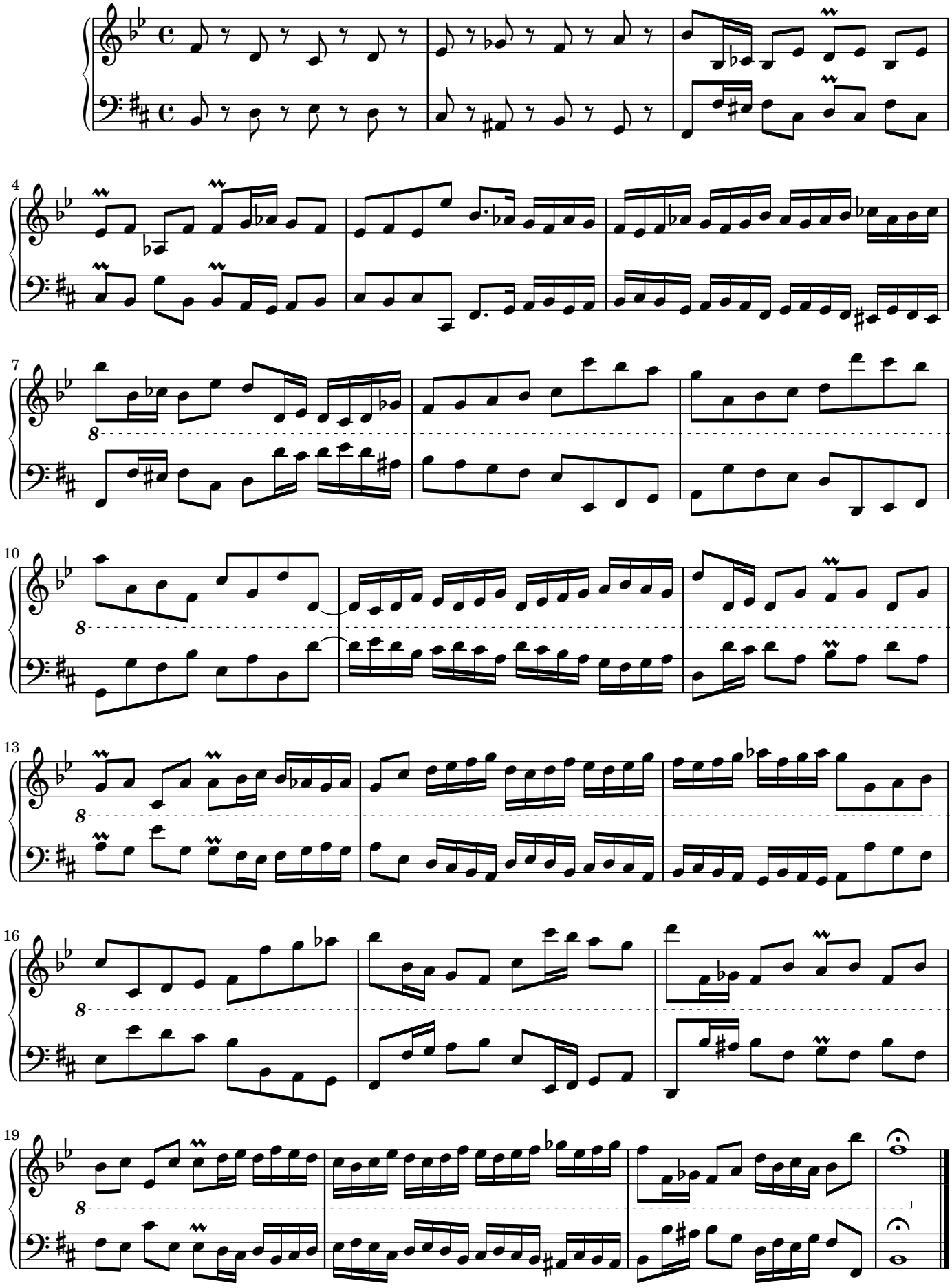
Invention 15, BWV 786

Benjamin Pritchard, after Johann Sebastian Bach

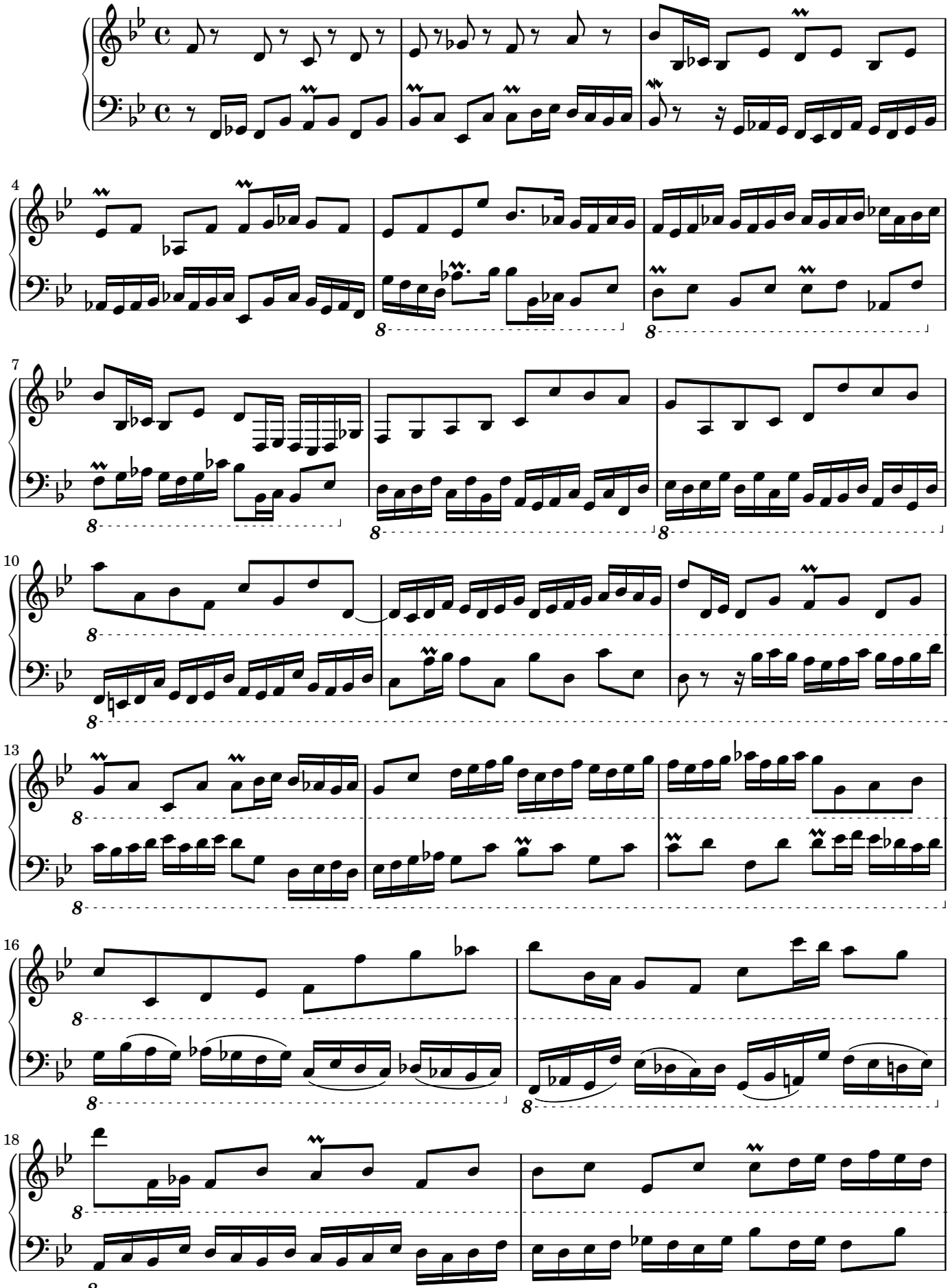
Right Hand Descending

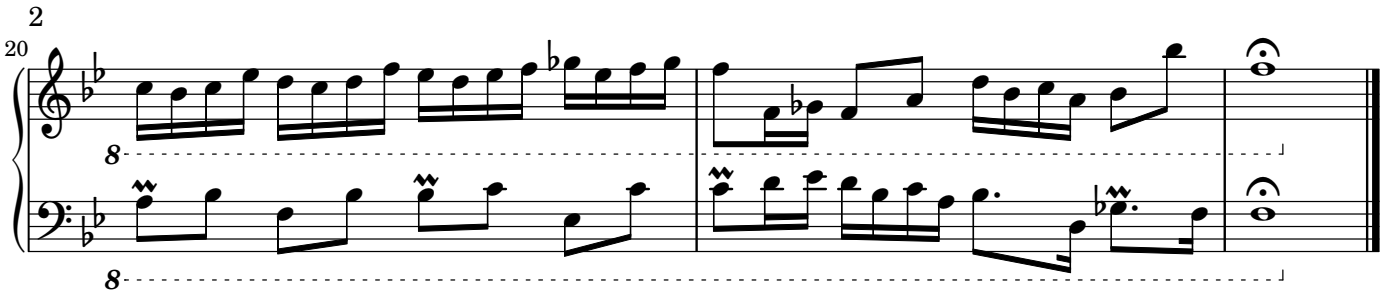


Invention 15, BWV 786

Benjamin Pritchard, after Johann Sebastian Bach

Mirror Image

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