

Darwin and Wagner: Evolution and Aesthetic Appreciation

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Introduction

Two of the most influential works of the Western nineteenth century were completed in 1859: Charles Darwin's *The Origin of Species* and Richard Wagner's opera *Tristan and Isolde*. Although created within very different cultural traditions, these works show some striking similarities: both brought about a critical, long-lasting debate and caused conflicting reactions after their publications, and both had fundamental and compelling impact on their disciplines. The perspective discussed in this paper, however, is that both works address the notion of evolutionary thought. In 2009 we could have thus celebrated a double anniversary: it was 150 years since the manifestation of the evolutionary idea in such different disciplines as music and biology.

In this article I focus on the following questions: (1) How is the idea of evolution expressed in *The Origin of Species* and *Tristan and Isolde*? (2) What are common essences of that which Darwin referred to as "descent with modifications" and Wagner to as "becoming" ("das Werden")? (3) What educational potential exists for exploring and understanding evolution when comparing its historical emergences in biology and music? Using a phenomenological approach, my aim is to survey, describe, and compare significant parallels between the two works rather than explaining the connections in terms of causality (which anyway would be impossible). When approaching the Darwin-Wagner kinship, my main presupposition is that their works can be regarded as imprints or manifestations of common ideas and essences expressed in such different disciplines as music and biology.¹ I am aware of the fact that focusing on merely the evolutionary dimension of these two works necessarily will exclude other significant aspects. I deliberately avoid

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discussing the highly controversial legacies of both men's works: the (mis)-use of Wagner's music and art views in the Nazi Germany political movements and the neo-Darwinian dispute on creationism and intelligent design. Rather, I expand the comparison of the two works to considerations of how teachers can facilitate students' meaningful learning of evolution and which joint role art and science might play.

My Interest in the Idea of Evolution

I first came upon the curious connection between the *Origin* and *Tristan* in the middle of the 1980s. During my five years of studying life sciences, I had been especially interested in the descriptions of living nature. What is genuine living? How can one explain what makes an organism a whole, more than a mere sum of its composite parts? And how do organisms change over time? In spite of the definition of biology as the *study of life*, I couldn't quite recognize the living itself: it seemed to vanish in schemes, physiological models, and chemical compound-based explanations. I had some vague idea of the living being somewhere "in between" the molecules, cells, and organs—something that kept it all together, but that itself was intangible. During these years of learning science, the *history* of science was hardly touched upon, and I had very few chances to reflect on the fact that this knowledge at one point in history actually had been new. On my own I gained insight into Darwin's remarkable life and revolutionary theory. The fascinating story of the emergence of the 1859 publication of *Origin*, inevitably connected to Darwin's biography, was not only history reading; it was the story of the becoming of an idea and its reluctant acceptance by society.

During my years of studying music, I met a totally different attitude toward the importance of history. Here, music history had a self-evident role in the curriculum; it was regarded as a necessity for understanding the nature of music, musical performance, and (in my case) musical composition. This view on history taught me to regard development of musical thought and practice as a stream of continuous change. Later I fully realized that this consciousness is especially important for the composer if his/her aim is to contribute something new to the already vast field of music. In my music history class, we eventually came to the great works of the European romantic period, and here Richard Wagner's music, and especially *Tristan*, was of profound significance. I remember very well noticing that 1859 seemed to be an outstanding year in music history, just as I knew it was in the history of biology. But was it a mere coincidence that both *Tristan* and *Origin* were completed in the same year? Might there be more significant connections between the two works? As my final project in music history, I chose to investigate the 1859 crossing of the two disciplines of biology and music, expressed in *Origin* and *Tristan*. With benevolent support from my professor in music history, I was able to finish the project in time.²

Writing the 1988 essay was an initiation to a now more than twenty-year interest in the coherency of *Origin* and *Tristan*. Since then, I have been accompanied by a curiosity regarding how art and science essentially express the same idea. A shared idea might sometimes be difficult to recognize because of discipline borders and obvious differences in form and language. In the 2009 recurrence to *Tristan* and *Origin*, I am diving deeper into their common features. In my current practice as an educator of preservice science teachers, I have great interest in finding ways to cross the art-science borders and to explore their common grounds for learning and teaching.

Existing Research on the Darwin-Wagner Kinship

There are only a few scholars who have noticed the parallels between Wagner and Darwin. This question—why is there a lack of mutual acknowledgment, both from music and science?—is in itself interesting; I will discuss it more thoroughly in the last section of this paper. A few authors are touching on this kinship without making it a main issue. Giuseppe Sermoniti, for example, points to the resemblance in that both Darwin and Wagner are dealing with the “whirlpools of becoming.”³ His juxtaposition does not, however, comprise an elaboration on how the idea of evolution is expressed biologically and musically.

One of the first attempts to make such a connection is Jacques Barzun’s *Darwin, Marx, Wagner: Critique of a Heritage* from 1941. Here, Darwin’s theory of evolution is compared with Marx’s social theory and Wagner’s music and aesthetic view. What they have in common, Barzun argues, is that all represent a worldview essential for the emergence of fascism and communism. Thus, they embody a triangle of evil, being responsible for “the cold world” and the dominance of a materialistic ideology. Barzun’s attempt to connect Darwin and Wagner essentially comes down to his claim that Wagner too “had seemingly made final the separation between man and his soul.”⁴ Barzun interprets the notion of evolution in Wagner’s aesthetic as “the progress of culture ultimately requiring the union of the arts in a popular synthesis of sociological import.”⁵ This attempt to connect a particular interpretation of Darwinism to Wagner seems to be politically biased. The conclusions are drawn without making a clear distinction between Wagner’s own aesthetic foundation and the (mis)interpretations of this after Wagner’s death. It seems obvious that Barzun’s comparison does not do justice to the evolutionary character, neither of Darwin’s conception of nature nor of Wagner’s conception of drama and music.

Gar Allen more convincingly elaborates on the evolutionary character expressed in Darwin and Wagner’s work. He too discusses the confluence between Marx, Darwin, and Wagner, but he enters the 1859 publishing of *A Critique of Political Economy*, *The Origin of Species*, and *Tristan and Isolde* from a cultural historical perspective. Allen criticizes Barzun’s comparison for its

reductionism: in Darwin's case, nature is reduced to a "constant struggle, battle, carnage and death"; in Wagner's case, art is reduced to "nothing more than the forcing of the artist's will onto mesmerized listeners, an assault on sensibility, the domination of the one over the many, and thus laying the psychological foundation for fascism."⁶ Instead, Allen points to their remarkably similar evolutionary view of the world. With special reference to the *Der Ring des Nibelungen*, Allen shows that evolutionary traits are found in Wagner's drama. In this paper I extend this comparison by carefully examining these evolutionary traits in the music itself. For my own discussion of parallels between *Tristan* and *Origin*, Allen's claim of the dialectics as a driving force in both Darwin's theory and Wagner's music is most stimulating: "Those interactions include, most fundamentally, a dialectical component, that is, the interaction of contrasting, opposing, or contradictory processes (forces). The contradictions lie fundamentally within the system, but also encompass those between the system and its external conditions or environment."⁷ I will return to the notion of dialectics in the discussion following the survey of *Origin* and *Tristan*.

Evolution in *The Origin of Species*

The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life was published in London on November 24, 1859. The reactions were immediate: the first edition of 1,250 copies was sold out the first day; the book was reprinted several times; and by the time of Darwin's death in 1882, six editions had been published. In England alone the book sold as many as 16,000 copies in the first thirteen years, at that time an enormously high number. The work was written as "an eminently readable book for the general public, not as a technical monograph for scientists,"⁸ a fact that might be one of the main reasons for its popularity. The debate started immediately, involving not only naturalists and theologians but also philosophers and the engaged public. The news about the book and its controversial conclusions soon spread to other countries. In Germany *Origin* was available by early 1860, translated by the pathologist Heinrich Bronn. The same year the book was published in the United States, the first French translation came in 1862 (although it had been reviewed in French scientific journals a year before), and the first Russian translation came two years later. What made this into such a debatable book, and why was Darwin's scientific argument so provokingly new?

The creation of Origin

Darwin was not the first to formulate an idea of change in the living world in terms of new species emerging. A development in nature from simpler to more complex forms had been claimed already by the Greek nature philosophers. Also among naturalists and geologists in the late eighteenth

and early nineteenth century, there was a growing conception of nature in terms of the emergence of new life forms. But what scientific explanation could account for the diversity of forms and species found in nature and their changes over time (evidently shown in fossil findings)? The attempts to formulate unifying laws for the manifold expressions of nature were built on findings brought about by prominent geologists like James Hutton and Charles Lyell. They showed that Earth is millions of years old and that the processes that formed the Earth in the past must be the same processes that operate in the present. In *Principles of Geology* Lyell claimed that Earth's surface and geological features have been shaped over long periods of time and that past events might be explained by examining today's observable processes. Lyell was the one who made Darwin aware of the significance of geological phenomena, and in *Origin* Darwin repeatedly draws on findings of fossils to support his theory. On the "affinities of extinct species," for example, he writes: "On the theory of descent, the full meaning of the fact of fossil remains from closely consecutive formations, though ranked as distinct species, being closely related, is obvious."⁹

When seeking an answer to the question of the mystery of the origin of life, Darwin built on previous theories, especially those of his grandfather Erasmus Darwin and Jean-Baptiste Lamarck, the French naturalist. These two naturalists had independently proposed theories stating that plants and animals were not directly controlled by a divine creator but spontaneously generated out of inorganic matter.¹⁰ In 1809, Darwin's year of birth, Lamarck published a theory where he proposed that organisms acquire certain characteristics during their lifetime that are passed on to one's offspring. In Lamarck's view all organisms are continually acquiring features that help them adapt to the environment more successfully. Certain animals, for instance, stretch their necks to reach leaves high in trees. This would strengthen and gradually lengthen their necks and over a long period of time originate what we today know as the giraffe. The notion of inheritance of acquired characteristics, however, soon proved to be inadequate: Lamarck (like Darwin) had no understanding of how traits are inherited and did not know that an organism's behavior was not directly affecting its inheritable characteristics. Lamarck was, however, an influential early proponent of the concept of biological evolution and was among the first to formulate a theory of evolution that took into account that organisms adapt to their environments. His theory had a stimulating effect on Darwin's own struggle to formulate a plausible explanation for the evolution of living organisms.

Darwin made his legendary voyage around the world as a naturalist with the HMS *Beagle* from 1831 to 1836. Whenever the ship came to a harbor, Darwin went ashore to collect plant and animal specimens. While organizing his ever-growing collection, he also read scientific works and made extensive notes about the observations he made. He combined Charles Lyell's principles of geological processes with his own observations of the varieties

of living and fossil species, hereby asking himself: If the Earth could change over time, might not life as well change? He began to ponder the notion of small modifications leading to large effects, a thought that fundamentally contributed to the development of his theory.¹¹ Immediately after returning to England, he began systematically reviewing his enormously large collection of findings. He had the sketch for a theory ready by 1838, partly written out in 1844, but waited with the publication until he could be absolutely sure that his conclusions were scientifically evident. After having received a short essay from Alfred Russel Wallace, a fellow naturalist who had “arrived at almost exactly the same general conclusions that I have on the origin of species,”¹² Darwin felt more or less forced to publish his work. After the double presentation of his and Wallace’s work before the Linnean Society in June 1858, Darwin used thirteen months to produce a tightly argued book.

The idea of evolution in Origin

In *Origin* Darwin’s two main points are *that* there has been a gradual evolution of living species and *what* the mechanism in this evolution is. Despite the title of his work, Darwin actually talks very little about from where the species have originated. The essentially new argument in *Origin* is the principle by which new species in nature emerged: “I have called this principle, by which each slight variation, if useful, is preserved, by the term of Natural Selection, in order to mark its relation to man’s power of selection.”¹³ Darwin relates the notion of natural selection directly to artificial selection, typically found in breeding and selection of plants and animals, such has been practiced in agriculture for thousands of years. “The key is man’s power of accumulative selection: nature gives successive variation; man adds them up in certain directions useful to him.”¹⁴ Darwin realized that the combination of high birth rates and a shortage of life’s basic needs inevitably would lead to a competition of resources: “Owing to this struggle for life, any variation, however slight and from whatever cause proceeding . . . will tend to the preservation of that individual, and will generally be inherited by its offspring.”¹⁵ The notion of “survival of the fittest”—probably the one most of us associate to the Darwinian theory—does not appear in the *Origin* before the fifth edition of the book. **This iconic expression, originally coined by Herbert Spencer, suggests that the fittest organisms are those able to adapt successfully to new surroundings. By repeatedly comparing artificial to natural selection, Darwin display the difference in purposefulness: Whereas artificial selection is goal-oriented, a selection for intentional improvement, natural selection is not, in spite of the fact that it leads to improvements for the species. The somewhat ambiguous notion of evolution lacking a goal, but at the same time leading to improvements, I will elaborate more on later (when discussing students’ learning of evolution).**

Although Darwin’s theory commonly is known as *the* theory of evolution, Darwin does not use the term “evolution” in *Origin*. There is,

however, one exception: in the very last sentence of the concluding chapter of the book, where Darwin describes the “forms most beautiful” that “have been, and are being, evolved.”¹⁶ Instead, Darwin uses words like “change” and expressions like “mutation of specific forms” and “process of modification.” His expression closest to what we today know as the theory of evolution is probably “descent with modification through natural selection.”¹⁷ Darwin’s avoidance of the term “evolution” might be due to its connotations in the nineteenth century’s scientific debate: The term had originally been applied to embryonic growth, and it took on its modern meaning in the mid-nineteenth century through a deliberate extension into all areas of development.¹⁸

Darwin was not able to explain the origin of *variation* within a population, a premise his whole theory is built upon. The scientific explanation for this was provided through the works of Gregor Mendel, first published in 1865 but rediscovered at the beginning of the twentieth century. This led to the establishment of genetics, the study of inheritance. Today the idea of genetic variation and sudden appearances of new individuals in a population through mutation is regarded as an essential supplement to the theory of natural selection. Still, Darwin’s idea of evolution challenged fundamental scientific and religious beliefs at the time of its publication and in the years to follow. The questions following this—where do we come from? where do we go? is there a purpose in Nature, in our lives?—transcend the narrow borders of biology or science. Regardless of the many controversies and debatable questions it engendered, *The Origin of Species* represents the scientific breakthrough of a theory of nature as an immense changing flow of forms—life as a continuous transformation.

Becoming in *Tristan and Isolde*

Richard Wagner completed the full score of *Tristan and Isolde* on August 6, 1859, in Lucerne, Switzerland. However, due to the immense demands the score put on both musicians and singers, it took nearly six years before the entire opera was performed. As a full opera, *Tristan* had its first performance on June 10, 1865, in Munich. Since then the opera has been regarded as a milestone in Western music; it is acknowledged as the culmination of German romanticism and at the same time the turning point of the development of tonal music, inevitably leading to atonality. In what ways was this work regarded as radically new, and how is evolutionary thought expressed in it?

The origin of Tristan

Originally Wagner had intended *Tristan and Isolde* to be a simple work, an opera that could easily be performed in the smaller province theaters. Compared with “the immense undertaking of the *Nibelungen*,” when planning

Tristan he “had in mind a practicable work” with “a few good singers.”¹⁹ Wagner had broken off working with the opera cycle *Der Ring des Nibelungen*; at the time of *Tristan*’s first performance, only *Das Rheingold* and *Die Walküre* had been completed. For several years Wagner had thought of writing an opera based on the Celtic love story, and in August 1857 he stopped in the middle of the second act of *Siegfried* to start on *Tristan*. By September he had finished the *Tristan* poem, and the composing of the opera itself took place in the period from 1857 to 1859.

In order to understand the huge impact *Tristan and Isolde* has had on both the aesthetic debate and musical expression since its first performance, some major influences should be highlighted. Wagner often referred to the music of Ludwig van Beethoven as a source of inspiration. In his later works Beethoven pointed out a modern expression that clearly is perpetuated in both Wagner’s thoughts on the *new drama* and in his musical style. In the last movement of Beethoven’s Ninth Symphony, completed in 1824, the human voice for the first time is introduced in an instrumental form. The entire movement is an attempt to explore the possibilities of the musical material presented in the previous movements. After (unsuccessfully) having recapitulated the thematic material, the human voice—first as solo voices, then as a whole choir—is introduced. For Wagner this represented the inevitable need to transcend the pure instrumental musical form and merge vocal and instrumental expression into one. This fusion is exhaustively examined in Wagner’s *Opera and Drama* (from 1851). Also in Beethoven’s demanding late string quartets we find anticipations of Wagner’s music. *Große Fuge* in B-flat major (Opus 133) is a single-movement composition for string quartet, originally planned as a finale of Opus 130 (1825). Due to its complexity and suspended character, Beethoven was unable to fit it into the standard form of a quartet movement. Suspension of harmonic resolution would, as I soon will come to, become a core feature of *Tristan*.

A strong and supportive advocate of Wagner and his music was Franz Liszt. In an extensive letter correspondence during many years, Wagner described and discussed his artistic ideas and the possibilities of having his operas performed. Liszt was kept updated on the progress on composing *Tristan*, and he was among the first to congratulate Wagner as it was completed.²⁰ In the period of Wagner’s exile from Germany due to his treasonable role in the 1849 uprising in Dresden, Liszt was, together with the conductor and pianist Hans von Bülow, Wagner’s most faithful benefactor. In 1850 Liszt produced *Lohengrin* in Weimar, and this was the last premier of one of Wagner’s operas until *Tristan* was put on stage in 1865. Although very different in musical expression, Wagner explicitly acknowledged Liszt’s influence on his music, especially when it came to harmony.²¹

Taking these influences into account, *Tristan* also owes its reputation as the crucial contributor to the resolution of tonal harmony to Arnold Schönberg. In a historical perspective *Tristan* anticipates the twelve-tone

harmonic, dodecaphony, developed at the beginning of the twentieth century. Schönberg was the first to formulate dodecaphony; the suite for piano *Fünf Klavierstücke* from 1923 is his first completely twelve-tone work. The close relationship between Wagner and Schönberg was a recurring observation already at Schönberg's own time. Thomas Mann, for instance, notes that Wagner "in *Tristan* already stands with one foot in atonality."²² The bold harmonic and melodic traits found in Wagner's *Tristan* are fully developed in Schönberg's music. It should be added, however, that Schönberg's groundbreaking works have contributed decisively to the position Wagner's music, and especially *Tristan*, has today.

Evolutionary traits in the drama

While working as a conductor in Dresden in the 1840s, Wagner had come across the Celtic love story of Tristan and Isolde. From a complicated and detailed story, Wagner developed the libretto for his opera, giving it a very simple structure. The setting is the Celtic world of the early Middle Ages, the number of characters few: Tristan and his servant Kurwenal; King Marke, Tristan's uncle, and his squire Melot; and Princess Isolde and her maid Brangäne. Act 1 starts as Tristan is returning from Ireland with the Princess, who is to become the queen to King Marke. Isolde recognizes Tristan as having killed the man she was to marry. In this encounter Tristan was mortally wounded and he sought Isolde's healing power. About to take revenge, Tristan looked up and gazed into her eyes. At that moment they fell in love, although each concealed this love from the other. Now Tristan is bringing Isolde for his uncle, King Marke. Still in love with Tristan, Isolde declares that, before reaching land, they will be united in death. Both Tristan and Isolde drink the potion, believing it to be a death potion, without knowing that Brangäne has substituted it with a love potion. In act 2 King Marke and his men have left for a night's hunt, and Isolde and Tristan meet, cursing the light of day and welcoming the night. Brangäne, keeping watch from a tower, warns that the night is passing. As daylight begins, King Marke and his men surprise them. Melot rushes at Tristan who lowers his guard and receives a savage wound before falling back into the arms of Kurwenal. In the final act 3, Tristan has been taken to his castle in Brittany by Kurwenal, who has sent for Isolde to heal Tristan once more. As Kurwenal sees Isolde's ship approaching, Tristan excitedly tears off his bandages, for Isolde has come to heal him. Laying in her arms, Tristan breaths his last word—"Isolde." A second ship arrives with King Marke, assuring that he has come, too late, to unite the lovers. Isolde, now roused once more, sees only her Tristan, transfigured and smiling as, together, they are united in death.

The outer structure of the opera is astonishingly simple: In the opening act Isolde is the main character whereas Tristan is the center of the third act. The second act, taking place in the darkness of the night, belongs to Tristan and Isolde. The complexity of the drama is to be found on an inner level.

The two lovers' relationship is driven by a never-ending tension between polarities—day and night, light and darkness, life and death, love potion and death potion. Their love, as impossible as it is, can only be brought out in the protection of night, far away from the daylight realities. Here, we find the romantic artist's affection for the night: "The night is home and kingdom of all romanticism."²³ In the famous love duet in act 2 Tristan and Isolde praise the night and ask to be released from this world:

O fall, sweet night, upon us both,
 Though night of love; give us oblivion,
 Make us forget that we are living.
 Ah, take us to thy breast!
 From the world free us!²⁴

Another polarity in the drama is the tension between loyalty and betrayal. Tristan finds himself in a position where he in all cases will have to appear as a traitor: If he is loyal to his king and uncle, he must leave Isolde and thus betray his love for her. If he, however, remains true to his love for Isolde, he simultaneously betrays King Marke. These tension-creating elements give the drama its characteristic dramatic advance, elements that correspond to the suspended tension so prominent in the harmonic language and in the form of the opera.

A further characteristic of Wagner's opera is the blending of all accessible artistic elements: text with music, instrumental sound with vocal parts, and scenography with the core idea of the drama. In the new drama, Wagner argued, all elements must merge to create a "complete and living body, when it consists of all the members whose mutual conditionings and supplements make up its whole": The ideal is the human body; "[the drama] has only this in common with its human prototype,—that it is living, and draws its life from inner life-needs."²⁵ The intention of creating a *Gesamtkunstwerk* by melting all elements into the drama also had consequences for the staging. In his own *Festspielhaus* in Bayreuth, Wagner was the first to demand that the lights be dimmed during the performances. His theater was the first to make use of the sunken orchestra pit, which at Bayreuth entirely conceals the orchestra from the audience. The ideal was the perfect blending of instrumental and vocal sound.

The idea of becoming in Wagner's writings

Richard Wagner extensively described both his notion of the new drama and the process of composing *Tristan*. In the first part of *Opera and Drama*, Wagner makes an extended attack on contemporary opera. He criticizes especially Italian and French operas, which he finds characterized by "ready-made"

melodies: "These [contemporary opera-composers] apprehended Melody as something lying outside of the realm of their art-production, as something ready-made; Melody, in whose organic generation they had taken absolutely no part."²⁶ This formation of "ready-made" melodic material Wagner opposes to melodies developing in "an organic manner." The prototype for such an "organic generation" Wagner finds in Beethoven: "With Beethoven, on the contrary, we perceive the natural thrust of Life, to breed the Melody from out music's inner Organism."²⁷ Wagner's repeated references to organic growth clearly show that he is deeply influenced by the concept of organicism and the mechanism-organism debate of the mid-nineteenth century: Mechanistic explanations of organic processes by reducing them to the molecular level were opposed to *organicism*, the notion of the whole being more than its parts. Wagner's notion of "organic generation" of music is in line with the claims of biological organicism that an organism "can exhibit higher-order functions even though the operation of each part is governed solely by physical law."²⁸ The "organic generation" of music is not merely a feature of the drama itself; in order to grasp its essence, one must *take part* in its generation. Wagner does not refer to development as evolution, an expression we have seen Darwin also avoids, but rather as a *becoming*:

A ready-made melody—so we have seen—remained unintelligible to us, because open to arbitrary interpretations; a ready-made Situation must remain just as unintelligible, even as Nature herself remained unintelligible to us so long as we looked on her as something *made*—whereas she is intelligible enough, now that we know her as the Being, i.e. the forever Becom-ing: a Being (*ein Seiendes*) whose Becoming is ever present to us.²⁹

Here, nature is a metaphor for the new drama: Nature is, Wagner claims, ever-changing, and this essential feature remains hidden to us as long as we regard her merely as an object, something *finished*. Interesting enough, Wagner does not substitute the notion of Being with Becoming, the first being the static, the latter the ever-changing new. Rather, nature—and so also the new drama—shows her Janus face by revealing herself as *both* Being and Becoming; "a Being whose Becoming is ever present to us." The task of the opera is to enable its audience to *experience* the process of change by taking "an active share" in the generation of the drama: "Plastic art can display only the Finished, i.e. the Motionless; wherefore it can never make of the beholder a confident witness to the becoming of a thing. . . . The Drama, alone, is the artwork that so addresses itself in space and time to our eye and ear, that we can take an active share in its becoming, and therefore can grasp the *Become* as a necessity."³⁰ Because the opera is a form in both space and time, the composer is compelled to investigate "the *Become* as a necessity." This is exactly what Wagner does in *Tristan*, his most radical artistic manifestation of the ideas formulated in *Opera and Drama*.

The idea of becoming in the music

The genuine new in *Tristan* is above all its interweaving of dramatic, harmonic, melodic, rhythmical, and formal elements. It is with this whole in mind that I now take a closer look at the musical elements and how these elements contribute to the opera's evolutionary character.

In *Tristan* the pending, unfinished *harmony* is prominent. Wagner intends to avoid progressions with too obvious harmonic effects. He introduces this already in the very first chord of the opera, the so-called "Tristan-chord":



Figure 1. The Tristan-chord in the second bar of the Prelude to *Tristan and Isolde*, and the unresolved dominant-seventh chord to which it progresses (bar 3).

The first melodic line ends on a dissonant seventh chord that is resolved in the following bar, not to a consonance that one would expect within a tonal context but to *another* dissonant chord (which also remains unresolved). The consequent avoidance of resolving dissonances creates a feeling of ongoingness and unfinishedness—and incertitude. “The ear is made insecure, without another certainty being offered in return,” as Heinrich Poos notes.³¹ In the opera, harmonic suspension is realized through several means: many modulations, ambiguous chord resolutions, and harmonic functions; other chord resolutions than expected (deceptive and incomplete cadences); and an extended use of chromatic melodic lines. Approaching a cadence is more often than not blocked by a quick and unprepared switch to a sharply contrasting key. The harmonic resolution is thus continuously postponed, invoking a hanging, suspended feel. The harmony is continuously challenging tonal harmony's most distinct feature—the final returning to the tonal center, the tonic.

Also the *melodies* have the quality of being unfinished and in progress. They are by no means “ready-made”; they continuously take part in an “organic generation.” In the melodic lines, Wagner creates an ever-changing, nonstatic motion based on a set of recurring *leitmotifs*: short, melodic themes connected to a character, a place, or an emotion in the musical drama. Already in the first bars of the Prelude (see Fig. 1) we find two of the central leitmotifs in *Tristan*, both consisting of only four notes: the “suffering motif” starts on A and ends on D sharp, and the chromatic “longing motif” starts

on G sharp and ends on B. The leitmotifs constantly shift in register and instrumentation, relative to the importance of the particular leitmotif's association with the drama action at that particular point. Through the transformative use of leitmotifs, Wagner wants to tie the very fabric of music itself to concrete entities, that is, to people, objects, or events. Leitmotifs are "musical moments of feeling," themes that themselves evolve as the drama develops.³² The melodies are often marked by highly chromatic features. In act 1, scene 2, Isolde sings a chromatic ascending line starting with "O my loved one! O my lost one!" This line consists of four of the "longing motifs," starting on a D and proceeding through all twelve notes of the octave. The following thirteenth tone, an E flat, is the end of the chromatic line and at the same time the beginning of the "death motif," sung on "Head unto death devoted!" This is but one of numerous examples of how melodic lines, leitmotifs, and text are woven together in the dramatic development.

Regarding *formal characteristics*, Wagner claims (in *Opera and Drama*) that the new drama must possess the unity of the symphony with its web of transformed and modulated themes. The drama should thus not consist of a chain of separate arias, recitatives, and ensemble parts. The dramatic tension must not be interrupted by virtuous solo parts or other disturbing elements. Even though *Tristan* has many solo parts, they are not in effect soli, at least not compared to the ones found in Italian and French opera. The ongoing generation of melodies and the suspended harmony postpones the drama's end in terms of the full cadence that establishes tonality. This is first to be found in the "Transfiguration," the very last scene of the opera. The development from the beginning of the Prelude to this end represents, as Wagner proclaims in *Opera and Drama*, "a growing from below upwards."³³ Whereas the Prelude (seemingly) starts in A minor, the ending of the opera is (clearly) in B major: after nearly five hours the tonality has "grown upwards" merely a major second, from A to B. The whole Prelude is an extension of the idea embodied in its first chords, centered on the Tristan-chord.³⁴ In spite of the independent character of the Prelude, having been performed before act 1 was completed (it had actually two performances even before Wagner finished the opera), the whole opera is one large dramatic development evolving out of the seeds planted in the Prelude. This is in contrast to operas of Wagner's contemporaries, who normally wrote the prelude after the opera itself, displaying its highlights.

Links between *Origin* and *Tristan*

These accounts for *Origin* and *Tristan* are by no means complete; they merely serve the purpose of a comparative analysis of their evolutionary characteristics. In this section I will describe and discuss overlappings of

the two works and show that the characters of the two works become more distinct when compared to each other.

Do the biographies of Darwin and Wagner overlap?

When studying the curious parallels between these two works, one obvious question emerges: Are there any biographical connections between Darwin's struggle to formulate a theory of evolution and Wagner's artistic works? So far I have not found proof that Darwin ever referred to Wagner, to Wagner's music, or to the discussion of musical aesthetics taking place in continental Europe at that time. Darwin did make some remarks on art; these are, however, peripheral compared to his scientific work. Wagner, on the other hand, made several remarks about Darwin's theory and publications. The first is from February 10, 1873, notated in his wife Cosima's diaries: "In the evening we began Darwin's *Origin of Species*, and R. observed that between Schopenhauer and Darwin the same thing happened as between Kant and Laplace: the *idea* came from Schopenhauer and Darwin developed it, perhaps even without having known Schopenhauer, just as Laplace certainly did not know Kant."³⁵ This entry shows that Wagner was engaged in discussions of his time, encompassing fields other than art and music. Wagner's comment on the connection between Darwin and Schopenhauer is interesting for several reasons. First, Wagner here points to a common *idea* as the connecting link between different expressions (Kant and Laplace, Schopenhauer and Darwin). The relation between idea and expression is an approach to describing commonalities between forms of cultural *manifestations*—philosophical, artistic, and scientific, which I will return to later in this section. Secondly, Wagner indicates that the ideas of Arthur Schopenhauer are expressed in Darwin, "perhaps even without having known Schopenhauer." This statement confirms the large impact Schopenhauer had on Wagner's thought. He became acquainted with Schopenhauer's *The World as Will and Representation* in 1854, and it made a lasting impact on him. In a letter to Franz Liszt (from December 16, 1854) he writes that he has been occupied with Schopenhauer, "who has come to me as a heavenly present in my loneliness."³⁶ Schopenhauer claims that the will is a universal principle that pervades all existence in its various forms; the most extensive will among living beings is "the will-to-life, or the continuance of the species."³⁷ This will is particularly manifested in the tragedy of unfulfilled desire, a theme we recognize as the very driving force in *Tristan*. In Schopenhauer's basically negative philosophy, desire can never be satisfied, and therefore desire is the deepest source of human suffering. Schopenhauer points to the tragedy as the art form that provides a genuine copy of the will. He cites the musical drama as exemplary of the conception of tragedy, a fact that must have had a great influence on Wagner's thoughts of the new drama and of *Tristan*.³⁸ Music (especially with a clear developmental structure) is, according to Schopenhauer, able to represent the transformative power of will. This process must

lead from unconsciousness to full consciousness.³⁹ It is on this basis that we can understand Wagner's second comment on Darwin and Schopenhauer (from August 7, 1881): "The newspaper contains an article, 'Kant and Darwin', and R. points out how much superior Schopenhauer's interpretation of instinct is to that of Darwin."⁴⁰ Wagner recognizes a connection between Schopenhauer's philosophy and Darwin's theory of evolution, however, without elaborating on their kinship and without explicitly relating his own aesthetic view to Darwin. It is nevertheless interesting for this excursion into *Tristan* and *Origin* that Wagner here in reality provides a clue for how to search for a common ground.⁴¹

Darwin and Wagner lived extremely different personal lives, working within academic and artistic fields having very little contact with each other. This fact is not necessarily an argument against finding conjunctions between their works. On the contrary, finding no direct connections but finding evidently common features in their work supports the argument that one and the same idea can be expressed independently in two different expressions. This commonality might occur, paraphrasing Wagner, even without their creators having known about each other.

Shift of worldview

What is the essence of the idea of evolution that is formulated scientifically by Darwin and theoretically and artistically by Wagner? I will argue that both *Origin* and *Tristan* articulate the shift from one worldview to another: from change as a repetitive circular movement to development as a cyclic-like process. Let us look closer at how this shift is expressed differently in the two works. The harmony in *Tristan* is clearly embedded in a tonal tradition characterized by harmonic development around the tonic center, but it constantly exceeds its borders. A typical Viennese classic and early romantic sonata movement would start and end in one specific key. The apparent development in the sonata form is harmonically speaking an exploration into neighboring keys, a development that, however, always returns to the tonic key. The tonic represents a firm basis around which the music takes place. In *Tristan* the form is more like a spiral: the melodic-harmonic flow displays the same expanding and contracting gestures typical found in tonal music, but in the moment where the tonic center is approached, it is avoided and a new round starts, different from the previous. Also the drama itself moves in cycles; this is especially prominent in act 3.⁴² Change, as circles of various sizes and durations, is replaced with a spiral-like, perpetual development, akin to Wagner's idea of *becoming*.

The predominant view of change in nature preceding *Origin* was that of a God-created world in "static" movement: the observable changes—those of day and night, summer and winter, life and death—had existed in the present form since the creation of Earth. Due to an inherent order, the movement always returned to its point of departure, like the metamorphosis of

a plant from seed, via leaf formation and flower setting, to new seed. In *Origin* Darwin does not deny the cycling character of development, but one cycle is not identical to the preceding and the following cycles. The differences, even though slight and nearly unnoticeable, will over a long period of time bring forth substantial change. Because the modifications are so small, development in the evolutionary sense has been overlooked. Proof of this descent with modifications Darwin found in the fossil remains and emerging knowledge from geology. What is constituted in *Origin* is a situation of progress that basically is *open on both ends*: whereas the static-circular worldview vouches for stability and predictability, the dynamic cyclic view displays an incomprehensible beginning and a dim, unpredictable end. The spiral-like model is a state of **constant movement, replacing a notion of nature as fixed, ever-moving, and never-changing**. The spiral has, if not an explicit goal, then certainly a movement *forwards*, if not a specific origin, then clearly *away* from the previous, the past.

This emerging view of nature in constant development necessarily raises the questions of purpose and direction. Thomas Kuhn notes that the most provoking element in Darwin's theory was the lack of a goal-directed process: "The *Origin* recognized no goal set either by God or nature."⁴³ Darwin's main focus was on the laws that govern descent with modification, the struggle for existence and natural selection, not (at least not in *Origin*) from where and to where the evolution takes place. The notion of such laws governing the development is of course not directly transferable to *Tristan*. What we sense in the opera, however, is a state of continuous becoming, created by radically expanding the harmonic vocabulary and executing a chromatic vagueness so fluently. The drama awakes a sense of uncertainty and unpredictability that in its very nature is akin to that of an open development. But in this state of "Being whose Becoming is ever present to us"⁴⁴ there is a goal toward which the drama irrevocably moves: the uniting of Tristan and Isolde in death. The stages of this development are explicit in the "motion of Tristan and Isolde's coming to consciousness of their love at the end of act 1 to Isolde welcoming unconsciousness in the "Transfiguration" the end of the opera,"⁴⁵ a development that in fact is the opposite to the one Schopenhauer describes in *The Will*. Also, musically the opera has a clear direction toward an end, the final resolving of the suspended disharmony to a sustained B major harmony. Here, we obviously find a fundamental difference between *Origin* and *Tristan*.

Origin implied a fulfilment of the Copernican turn and the loss of a fixed point from where the rest of the universe can be regarded. It is on this basis we must understand the immense reactions following its publication. In a similar manner Wagner's daring opera implied an attack on the superiority of tonality and the tonic establishing stability. This might be what Friedrich Nietzsche, the German philosopher and Wagner critic,

sensed when referring to *Tristan* as a work of “dangerous fascination.” In his autobiography, *Ecce Homo*, he writes: “But to this day I am still seeking for a work which would be a match to *Tristan* in dangerous fascination, and possess the same gruesome and dulcet quality of infinity; I seek among all the arts in vain.”⁴⁶ What is so radically new in *Tristan*, what made it possess a “gruesome and dulcet quality of infinity”? Is it its quality of seemingly never-finished and ongoing process? Is it its pessimistic Schopenhauerian notion of unfulfilled desire as the deepest source of suffering and the necessity to transcend the external world, “the victory of night over day”?⁴⁷ Thomas Mann notes that *Tristan* is without doubt the “highest and most dangerous amongst Wagner’s works.”⁴⁸ Wagner himself also must have sensed this: even though he had intended *Tristan* to be a practicable work, he knew that he had embodied “the most daring and most exotic conception” in all his writing.⁴⁹ He was stunned by its radical expression. After having conducted the Prelude for the first time in January 1860, more than two years after the whole opera had been completed, Wagner exclaimed: “The little Prelude was so inscrutably *new* to the musicians that I at once had to lead my players from note to note as if we were exploring for precious stones in a mine.”⁵⁰

The idea of development as a smooth, seamless flow over time we find expressed by both Wagner and Darwin. In *Origin* Darwin repeatedly returns to the idea that the evolution is gradual and continuous, without sudden leaps: “On the theory of natural selection we can clearly understand the full meaning of that old canon in natural history, ‘Natura non facit saltum.’ This canon, if we look only to the present inhabitants of the world, is not strictly correct, but if we include all those of past times, it must by my theory be strictly true.”⁵¹ Since nature does not perform sudden leaps, development must have occurred as a long chain of slight modifications, over time eventually resulting in the emergence of new species. Wagner expresses something of the same idea in *Opera and Drama* when describing the drama’s organically growing melodies. On October 29, 1859, two and a half months after having finished *Tristan* and less than a month before *Origin* is published in London, he writes: “I should now like to call my most delicate and profound art *the art of transition*, for the whole fabric of my art is made up of such transitions: all that is abrupt and sudden is now repugnant to me.”⁵² *Tristan* is truly an artwork of transition with its long interwoven text-music textures, avoiding rapid changes and separate segments, in a continuous and developmental growth.⁵³ Wagner defines “organic growth” as “a growing from below upwards, an advance from lower to higher forms of organism.”⁵⁴ The drama itself must be in growth, beginning with the fixation of the lowest point, “from which we are to start that upward journey.”⁵⁵ Metaphorical notions of the “upward journey” we also find in *Origin*. When writing “for each new species is formed by having had some advantage in the

struggle for life over other and preceding forms," Darwin argues that recent forms are more "highly developed" than ancient forms.⁵⁶

Origin and *Tristan* both express a worldview of changing process; they both embody a crucial stage in the "transfer of interest from the permanent to the changing."⁵⁷ Both works enduringly changed their respective fields and disciplines but also Wagner's and Darwin's personal reputations. As the premiere of *Tristan and Isolde* in 1865 was a major turning point in Wagner's career as an artist, the 1859 publication of *The Origin of Species* was for Darwin as a scientist. When referring to the crisis of tonal music in the mid-1800s, *Tristan* is at its core. And whereas biology after *Origin* fundamentally is being understood in the light of evolution, *Tristan* paved the way for the public's appreciation of the tonal abandonment that rose in his aftermath.

Different manifestations of shared ideas

The immense importance of *Origin* and *Tristan* can of course not solely be interpreted on the basis of the works themselves and their history of reception; they are also articulations of the particular time and culture in which they occurred. The common theme of evolution is expressed in the two works in spite of large professional and personal differences between an English distinguished naturalist and family man and a German controversial composer. The evolutionary idea is embedded in the culture of the mid-nineteenth century with its emerging ideas of progress and development. Peter Bowler argues that at this time progress was a common theme uniting the debates in history, archaeology, anthropology, geology, and biological evolution. Evolution became an important theme "because it brought together parallel changes in attitudes towards human history, human origins and the development of life on earth."⁵⁸ Central in this debate was Darwin's *Origin* and its challenging of the church's hegemony over creation and man's place in nature. The Darwinian theory in its original form can, however, hardly be characterized as a revolution. It was a particularly precise articulation of an already-existing worldview characterized by the idea of progress.⁵⁹ It was first by the emergence of Mendelian genetics that the transition to modern Darwinism was completed.

When comparing Darwin's *Origin* to Marx's *Critique of Political Economy* (also published in 1859 and later incorporated into chapters 1, 2, and 3 of *Capital*), Gar Allen argues that both works deal with change in processes as developmental. Change, both in the organic and the social world, "comes about through a series of processes occurring both internal and external to the system being studied (a natural population or organisms or a society)."⁶⁰ In this sense history is more complex than simple chronology, a sequence of subsequent events, or an unfolding of a plan (divine or scientific laws). Here, we find a commonality between Darwin and Wagner

(and Marx) as they appear to reason from a “dialectically materialist,” as opposed to a “mechanistic materialist,” tradition: “While the philosophy of mechanistic (or mechanical) materialism sees all processes as composed of discrete, atomized parts each functioning independently, dialectical materialism is a philosophy that emphasizes interaction of parts within complex systems.”⁶¹ The dialectic process is marked by interactions of contrasting, opposing forces. The contradictions lie both within the system and between the system and its external conditions or environment.⁶² Contradictions in a biological population would be, for example, the struggle for survival in an environment with the tendency to outrun its food supply—that is, the contradiction between heredity and adaptation to changing environment. This polarity forms the very basis on which the whole theory of natural selection rests. As I pointed out in the Wagner section, the contradictory forces in *Tristan* constitute the tension-creating relationship between loyalty and betrayal, light and darkness, and life and death. These are forces *within the drama itself*, driving the drama to its inevitable end. The development of the drama is cyclic; it resembles the cycles of cultural development “formed by the swings from one side to the other” between contradictory forces “for which both are essential.”⁶³

Wagner’s concept of becoming and Darwin’s descent with modification can be compared by linking them to a common view of the world: the *Zeitgeist*, “which develops and carries with it the ideas of individual thinkers,”⁶⁴ and, I may add, the ideas shared by scientists as well as artists. The notion of ideas being transformed into actual expression is in line with Aristotle’s distinction between *in potentia*, that which is in a state of *not-yet* conceptual knowledge or artistic expression, and *in actu*, that which is expressed and has received an actual gestalt. The offspring of Wagner’s and Darwin’s works is the potentiality of shared ideas and attitudes at the time around 1859. Both the idea level and expression level are dynamic and mutually dependent upon each other. The notions of becoming and descent with modification, for example, are but two transformations of the *Zeitgeist* of the progressive spirit of the mid-nineteenth century. On the other hand, the very same notions have decidedly contributed to our current understanding of the spirit of that time.

Learning Evolution and Aesthetic Appreciation

At the start of this Darwin-Wagner exploration, I had two educational questions: Why should history have a much more predominant position in music education than in science education? And how can the notion of evolution be taught and learned by joint efforts of art (music) and science (biology)? In this last section I will examine educational lessons to be learned from comparing *Origin* and *Tristan*.

Students learning evolution

A major concern for current science education is that many students in science lessons find themselves faced with an abstract and purely cognitive world, separated from their everyday life experiences.⁶⁵ One challenge is that knowledge in science is increasingly being detached from its origin and history.⁶⁶ Several studies conclude that students have difficulties learning evolution. Students cannot, for example, distinguish between biological and cultural evolution,⁶⁷ and students tend to lean toward the idea that acquired traits are inherited (Lamarckianism).⁶⁸ In a study of reasoning about evolution among tenth- and twelfth-grade students, Tamir and Zohar found recurring use of anthropomorphic and teleological explanations. When directly asked why they use such expressions, the students replied that it made it “easier to understand,” that the theory was “more convenient to communicate using these expressions,” and that they were aware “that this does not prove the mechanistic explanation.”⁶⁹ In his study of the role of metaphor in Darwin’s *Origin*, Niklas Pramling suggests that there are two reasons why the theory of evolution is difficult to learn: (1) the metaphorical nature of the formulations of the theory in *Origin* could result in certain incorrect ways of reasoning; and (2) it requires an understanding of a time span that is incredibly difficult to grasp and thus best can be understood as a spatial and visual metaphor. Pramling suggests that when teaching evolutionary theory, “Darwin’s metaphors should be marked out and made explicit as metaphors and their role in how he conceptualized and communicated his theory should become part of the curriculum.”⁷⁰ In this perspective, students’ use of anthropomorphic metaphors to make meaning out of Darwin is not a misunderstanding of unambiguous knowledge content; these metaphors are mirrors of metaphors formulated in *Origin* itself. For example, Darwin introduces natural selection as a metaphor of artificial (goal-oriented) selection. Students, when recognizing purposefulness in nature, are (to a certain extent) in line with Darwin’s own initial approach to explaining evolution.

In *Origin* Darwin provides an explanation for the phenomenon of evolution. However, his book is more than an account of the mechanism of natural selection; it is an invitation to experience the grandeur of Nature. He thoroughly describes how the descent has led, and is constantly leading, to forms that have “come to a high stage of perfection.”⁷¹ What we witness are laws of nature in which “endless forms most beautiful and most wonderful have been, and are being, evolved.”⁷² In a poetical, empathic manner he writes: “I can see no limit to this power [nature selecting variations], in slowly and beautifully adapting each form to the most complex relations of life.”⁷³ Aesthetic descriptions like these clearly complement the pure scientific explanations provided in the book. When reading *Origin* “we find ourselves in a world of wonders, a world worth loving; we become participants

and observers in a life larger than us, and more meaningful."⁷⁴ When reading *Origin* we sense that beauty and magnificence is a part of the theory of evolution, not something merely added in order to make it more readable. To support students' creating a sense of meaning is a task for science teachers. One way science educators can facilitate students' understanding of evolution is by more explicitly highlighting this aspect of *Origin*: that Darwin embedded his theory of evolution in an affectionate appreciation of Nature. As George Levine argues, "the project of establishing the theory of evolution by natural selection was not so much the affirmation of a mindless and godless world, as the revelation that we walk in the midst of wonders; it was an act of loving engagement with the natural world that allows and fosters, even without gods and traditional forms of consolation, enchantment."⁷⁵

Now, we know that Darwin's whole fabric was one long argument against the idea of imposed purpose or a prior intelligent causal force to plan and predetermine the living nature. Any argument for viewing the world less "mindless and godless" might therefore easily be thrown into the unpleasant category of creationism and intelligent design. My point here is an educational one: If we are teaching our students exclusively the mechanism of evolution, this implies a reduction of the aesthetic view of Nature inherent in the theory in its original form. The view of nature as "a world of wonders" is part of Darwin's theory, and it is thus not necessary to impose an (extra-scientific) meaning *onto* the theory. It is a contradiction if we as science educators on the one hand impart a reductionist interpretation of the phenomenon of evolution whereas we, on the other hand, lament students' view on school science as abstract and detached from their daily lives. It is understandable—from an educational point of view also desirable—that students seek ways to connect themselves to what is taught. Students' intuitive uttering of anthropomorphic and teleological expressions might very well be used in making the theory "easier to understand" because they are aware of what is presented in class is "the mechanistic explanation."⁷⁶ Students might very well spontaneously reach for such expressions without having taken up a position between science and creationism. Instead of teaching the theory of evolution as one large ready-made explanation, it could be more fruitful to further examine what students intuitively perceive when reading *Origin* and trying to make meaning of its scientific *and* aesthetic dimensions.

Art, science, and aesthetic appreciation

This double case study of *Origin* and *Tristan* raises the educational question of how to gain a deeper understanding of the nature of evolution by equating biology (science) and music (art). First, I do not think that Wagner's *Tristan* (or any other of his music, for that matter) can be used to learn the mechanisms of natural selection, the struggle for existence, and other

concepts from evolutionary biology. This would be to reduce music (and art) to a mere means in the service of acquiring scientific knowledge. And I do not believe that Darwin's *Origin* can be used to illustrate bold harmonic progressions in music. Rather, this coalescence reveals some implications for how aesthetic appreciation might be incorporated in teaching evolution and how the characters of artistic and scientific inquiry might become clearer.

In *Origin* Darwin displays an aesthetic appreciation of nature that does not contradict but rather complements the scientific explanations. In music, and art in general, a sense for its aesthetic expression is crucial—yes, the ability of aesthetic experiencing is at its very core. Listening to *Tristan* and appreciating it as a work of art are more a matter of sensitivity than accumulated knowledge. Thus, the opera as an aesthetic experience cannot be replaced by any amount of knowledge about its evolutionary dimensions.⁷⁷ While comparing Wagner's opera to Darwin's theory of evolution, the aesthetic characteristics of *Origin* became clearer to me. I sensed Darwin's intention to embed his whole theory in a fascination of *nature in movement*. In *Origin* there is a sustained love and affection for the wonders of becoming in nature. This does not imply, however, that one can appreciate nature as if it were art. As Sheila Lintott argues, nature and an artwork have different features, and "by appreciating nature as art we either fail to appreciate nature at all or we appreciate it in an inappropriate, usually feeble manner."⁷⁸ Her conclusion, to appreciate nature as *nature*, is valid also when it comes to art—music should be appreciated as *music*. My main point here, however, is that the act of appreciation, practiced when listening to music, can help to experience the aesthetic dimensions of nature, dimensions often disguised by a mere instrumental interpretation of Darwin. The act of nature appreciation is an invitation to see beyond the mechanisms of evolution, at the same time avoiding reducing nature to an object to be enjoyed as a work of art (neglecting the unique properties of nature). In teaching Darwinian evolution, teachers may encourage students to draw on their experiences from music and art in order to understand how Darwin in *Origin* merges aesthetics and science.

Why does the history of science seem to have a less prominent position in science education compared to music education? Is it because science knowledge is regarded as "objective," free from personal touch, liberated from the fact that some individuals at certain points actually formulated this knowledge for the first time? In his study of Darwinian evolution in religious education, Tonie L. Stolberg argues that learning Darwinism is an opportunity for students "to gain an appreciation for the similarities and differences between the way science and religions make sense of our experiences."⁷⁹ The same argument can be used when viewing similarities and differences between science and art: that an historical exploration of the reciprocity of *Origin* and *Tristan*—in forms different, but in essence

related—can help students understand how a scientist and an artist respond to cultural and personal influences. Students can be encouraged to compare and contrast the scientist's and the artist's approach to creating meaningful understandings of the world. This might clarify the nature of scientific inquiry as complementary—and not opposed—to forms of art exploration.

The role of history in music and art education is connected to the consciousness of continuity: the works have been created by individuals who have transformed (new or shared) ideas into aesthetic expressions. The intention of teaching history is to present and reflect on artistic creation as both *results* of social and cultural conditions and at the same time crucial *agents* for history's further development. This understanding of the role of history is not less important for teaching science. If Pramling's conclusion is correct, that knowledge in science is increasingly being detached from its origin and history, then a more explicit focus on the evolution of scientific thought is one way of mending this gap. Darwin's theory is an excellent theme for such an exploration because it itself is about change, progress, and emergence of the new. Emphasizing the history of science might also stimulate students' critical thinking of science's apparent objectivity. It can help students develop a reflective understanding of science as being in constant progress and that some of what we hold to be true today was provokingly new 150 years ago. One way of introducing Darwinian theory in science teaching is by putting it on stage,⁸⁰ another is to let students compare Darwin's original text with the many interpretations and further developments of the theory. A third possibility is, in both science and music education, to focus more explicitly on parallels between the histories of science and music. This implies highlighting how common ideas are expressed contextually and historically in forms specific for science and art.

This comparative study has intended to bridge the gap between the so-called two cultures, a gap that according to C. P. Snow might be bridged "by rethinking our education."⁸¹ A rethinking of art and science in education might take place in (at least) two different manners: either through the blending of traditionally separated art and science disciplines to form new ones, or through an increased mutual acknowledgment of the differences between the domains of art and science. Stephen J. Gould argues that the true unification of science and humanities recognizes and acknowledges their essential differences as great ways of knowing; a unification based on "equal regard that respect[s] the inherent differences, acknowledge[s] the comparable but distinct worthiness, . . . and seeks to emphasize and nurture the numerous regions of actual overlap and common concern."⁸² It is in this sense of art-science rethinking that the comparison of *Tristan* and *Origin* is fruitful. Instead of evening out the differences between an opera and a work of science, their characters have become more distinct. *Origin* is more than a scientific theory based on logic and rational argumentation; it is an

aesthetic account of the wonders and beauty of nature. *Tristan* is more than a subjective piece of art; it clearly reflects dimensions of evolution akin to scientific explanations of the phenomenon. The Darwin-Wagner conjunction is an excellent example of how two individuals, working quite independently, express a similar idea. **Even though art and science are marked by contrasting, often conflicting and seemingly noncommunicative cultures,** in the case of *Tristan* and *Origin* these differences are more stimulating than disturbing. This conclusion might be utilized in both music and science education.

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NOTES

1. I also used this comparative method in my 2005 Einstein project. Here, I describe essential themes of which Einstein's physics is a physical-mathematical expression. These themes I subsequently reformulate into musical language and form, further using the comparison between physics and music as a source of reflection on the kinship of science and art. See Edvin Østergaard, "Composing Einstein: Exploring the Kinship of Art and Science," *Interdisciplinary Science Reviews* 31, no. 3 (2006): 1-14.
2. Edvin Østergaard, *Darwins "Artenes opprinnelse" og Wagners "Tristan og Isolde"—En sammenligning* [Darwin's "The Origin of Species" and Wagner's "Tristan and Isolde"—A Comparison] (Oslo: Norwegian Music Academy, 1988).
3. Giuseppe Sermoni, "Wagner and Darwin, Hanslick and D'Arcy: From the Whirlpools of Becoming to the Mathematical Beauty," *Rivista di Biologia* 97, no. 3 (2004): 361-64.
4. Jacques Barzun, *Darwin, Marx, Wagner: Critique of a Heritage* (1941; repr., Boston: Little Brown, 1981), 3.
5. *Ibid.*, 322.
6. Gar Allen, introduction to *Marx, Darwin and Wagner* (St. Louis: Washington University in St. Louis Press, forthcoming), 2.
7. *Ibid.*, 7-8.
8. Stephen J. Gould, *The Hedgehog, the Fox, and the Magister's Pox: Mending the Gap between Science and the Humanities* (New York: Three Rivers Press, 2003), 140.
9. Charles Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, facsimile of the 1st ed. (Cambridge: Harvard University Press, 1859), 336.
10. Janet Browne, *Darwin's "Origin of Species": A Biography* (New York: Grove, 2006), 37.
11. *Ibid.*, 33.
12. Darwin, *On the Origin of Species*, 2.
13. *Ibid.*, 61.
14. *Ibid.*, 30.

15. *Ibid.*, 61.
16. *Ibid.*, 490.
17. *Ibid.*, 459.
18. Peter J. Bowler, "The Changing Meaning of 'Evolution,'" *Journal of the History of Ideas* 36 (1975): 95-114.
19. Richard Wagner, *My Life* (German ed., 1880; London: Constable, 1994), 669.
20. "Dem vollendeten *Tristan* die herzlichsten Glückwünsche" (Weimar, 9. August 1859), *Franz Liszt–Richard Wagner Briefwechsel* [Franz Liszt–Richard Wagner Letters], by Franz Liszt (Frankfurt am Main: Insel-Verlag, 1988), 625.
21. Robert Bailey, *Richard Wagner: Prelude and Transfiguration for "Tristan and Isolde"* (New York: Norton, 1985), 21-22.
22. Thomas Mann, *Wagner und unsere Zeit. Aufsätze, Betrachtungen, Briefe* [Wagner and Our Time] (Frankfurt am Main: Fisher Verlag, 1983), 120 (my translation).
23. *Ibid.*, 97 (my translation).
24. Richard Wagner, *Wagner's "Tristan and Isolde,"* trans. Richard le Gallienne (New York: Frederick A. Stokes, 1909), 70.
25. Richard Wagner, *Opera and Drama*, trans. W. Ashton Ellis (German ed., 1851; Lincoln: University of Nebraska Press, 1995), 342.
26. *Ibid.*, 342.
27. *Ibid.*, 106.
28. Peter J. Bowler and Iwan R. Morus, *Making Modern Science: A Historical Survey* (Chicago: University of Chicago Press, 2005), 168.
29. Wagner, *Opera and Drama*, 337 (emphasis in original).
30. *Ibid.*, 337 (emphasis in original).
31. Heinrich Poos, "Die *Tristan*-Hieroglyphe," in *Richard Wagner; Tristan und Isolde*, ed. Heinz-Klaus Metzger and Rainer Riehn, *Musik-Konzepte*, vol. 57/58 (1987), 50 (my translation).
32. Allen, introduction to *Marx, Darwin and Wagner*, 3-4.
33. Wagner, *Opera and Drama*, 338.
34. Eric T. Chafe, *The Tragic and the Ecstatic: The Musical Revolution of Wagner's "Tristan and Isolde"* (New York: Oxford University Press, 2005), 36.
35. Cosima Wagner, *Cosima Wagner's Diaries*, intro. and trans. G. Skeleton (New Haven, CT: Yale University Press, 1994), 167 (emphasis in original).
36. Liszt, *Franz Liszt–Richard Wagner Briefwechsel*, 393.
37. Chafe, *The Tragic*, 35-36.
38. *Ibid.*, 33. Chafe also shows how the opening words of *The World as Will and Representation* is echoed in the love duet of act 2, "O fall, sweet night, upon us both," when *Tristan* and *Isolde* voice Schopenhauer directly—"Selbst dann bin ich die Welt."
39. *Ibid.*, 36.
40. Wagner, *Cosima Wagner's Diaries*, 436.
41. Wagner makes one further reference to Darwin, on October 23, 1877: "R. again had a wretched night, abdominal troubles—he reads Darwin (*The Descent of Man*), feels cold." See Wagner, *Cosima Wagner's Diaries*, 291.
42. Chafe, *The Tragic*, 44.
43. Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (1962; Chicago: The University of Chicago Press, 1996), 172.
44. Wagner, *Opera and Drama*, 337.
45. Chafe, *The Tragic*, 37.
46. Friedrich Nietzsche, *Ecce Homo*, trans. Anthony M. Ludovici (German ed., 1888; London: George Allen and Unwin, 1911), 43-44.
47. Chafe, *The Tragic*, 35.
48. Mann, *Wagner und unsere Zeit*, 53 (my translation).
49. Wagner, *My Life*, 710.
50. Quoted in Bailey, *Richard Wagner*, 27 (emphasis in original).
51. Darwin, *On the Origin of Species*, 206.
52. Richard Wagner, *Selected Letters by Richard Wagner*, trans. and ed. Steward Spencer and Barry Millington (New York: W. W. Norton, 1988), 475 (my emphasis).

53. The fact that there are elements of sudden change in *Tristan* (for example, the love portion) I will not elaborate on here.
54. Wagner, *Opera and Drama*, 338.
55. *Ibid.*, 339.
56. Darwin, *On the Origin of Species*, 337.
57. John Dewey, "The Influence of Darwinism on Philosophy," in *John Dewey: The Middle Works 1899-1924*, vol. 4 (Carbondale: Southern Illinois University Press, 1977), 7.
58. Peter J. Bowler, *The Invention of Progress: The Victorians and the Past* (Cambridge: Basil Blackwell, 1989), 5.
59. Bowler and Morus, *Making Modern Science*, 161.
60. Gar E. Allen, "Evolution and History: History as Science and Science as History," in *History and Evolution*, ed. M. H. Nitecki and D. V. Nitecki (Albany: State University of New York Press, 1992), 217.
61. Allen, introduction to *Marx, Darwin and Wagner*, 7.
62. *Ibid.*, 8.
63. Bowler, *The Invention of Progress*, 58-59.
64. *Ibid.*, 58.
65. Edvin Østergaard, Bo Dahlin, and Aksel Hugo, "Doing Phenomenology in Science Education: A Research Review," *Studies in Science Education* 44, no. 2 (2008): 93-121.
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70. Pramling, "The Role of Metaphor," 544, 545.
71. Darwin, *On the Origin of Species*, 183.
72. *Ibid.*, 490.
73. *Ibid.*, 469.
74. George Levine, *Darwin Loves You: Natural Selection and the Re-Enchantment of the World* (Princeton, NJ: Princeton University Press, 2006), 25.
75. *Ibid.*, 26.
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77. This idea is in accordance with Edward Winters, "On Aesthetic Appreciation," *Journal of Aesthetic Education* 32, no. 2 (1998): 1-10.
78. Sheila Lintott, "Adjudicating the Debate Over Two Models of Nature Appreciation," *Journal of Aesthetic Education* 38, no. 3 (2004): 53.
79. Tonie L. Stolberg, "Teaching Darwinian Evolution: Learning from Religious Education," *Science & Education* 19, nos. 6-8 (2010): 690.
80. Kirsten Shephard-Barr, "Darwin on Stage: Evolutionary Theory in the Theatre," *Interdisciplinary Science Reviews* 33, no. 2 (2008): 107-15.
81. Charles P. Snow, *The Two Cultures* (1959; repr., Cambridge: Cambridge University Press, 1988), 18.
82. Gould, *The Hedgehog*, 259 (emphasis in original).