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Review of Laurent Fichet, *Les theories scientifiques de la musique*

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[1] In 1862, Fetis curtly dismissed the ensemble of theories of his contemporary, Durutte, with the words "il suffit de l'expliquer pour le reduire au neant" ["It suffices to explain it to reduce it to nothing"]. In his recent work, "Theories scientifiques de la musique aux XIXe et XXe si鐃 les", Laurent Fichet proceeds to do just that and, with a candor that may at times embarrass the more gentle reader, provides a sharp critique of various and varied attempts over the last two centuries to espouse a "scientific theory of music."

[2] More precisely, Fichet limits himself to the most significant, poorly understood or ill-known theories from mainly French and German authors over the last two centuries, that are based on physics, acoustics, physiology, or mathematics. These are sciences that can establish facts with objectivity and certitude, explains Fichet, in contrast to sociology and psychology, which can often be the object of discussion without end. We learn that this work should be particularly useful to musicians, many of whom, either through disinterest or lack of scientific background, neglect these theories, even those of their favorite composers. The author's main conclusion is that most attempts to provide a scientific account of music, whatever this actually means, are at best quasi-scientific in nature, and often riddled with incoherence and logical inconsistency. Indeed, the reader is left to ponder at the end of the work whether it is at all feasible aspire to such a goal.

[3] Published in 1996 by Librarie philosophique J. Vrin, the work appears as the seventh in a series on music and aesthetics. Broadly speaking, its 382 pages are divided into four sections: a brief introduction is followed by a hundred or so pages on nineteenth century theories, leaving the bulk of the work to be devoted to mathematics- and physics-based theories from the twentieth century. A twenty-page conclusion attempts to thematically reunite the preceding sections, after which a still-curious reader may find a useful annotated bibliography organized by chapter, an index, and a more detailed description of the contents than is found at the beginning of the work.

[4] Opening with quotes from Rameau that "La musique est une science physico-mathematique" ["Music is a physico-mathematical science"] and that "la simple resonance du Corps Sonore donne la loi a toute la musique theorique et pratique" ["the simple resonance of the Corps Sonore accounts for all music theory and practice"], Fichet overviews the musings of seven post-Ramellian theorists, ranging from the wonderful to the just plain weird. The first three--Alfred Day, Jerome-Joseph de Momigny, Victor Derode--unsuccessfully attempt to demonstrate how the chromatic scale and harmonic practices at the time could be derived from an analysis of the resonance of the *Corps Sonore*, and their theories are variously criticized by Fichet for their intellectual gymnastics, logical inconsistency, and failure to correspond to musical reality. The avid reader then takes a trip into the wonderful world of Baron Blein, who declares with certitude but without calculation that the primary colours correspond exactly to the sounds produced by the major chord. The writings of three more theorists--Arthur von Oettingen, Anatole Loquin and E Guyot--are then briefly overviewed, again merely to be quickly dismissed as merely speculative in the case of the first, convoluted in that of the second, and unscientific in that of the third, whose assertions are excoriated by Fichet for being "as mysterious as they are inconsequential."

[5] The next portrait in this rogues' gallery is that of Camille Durutte. A little known French composer, and epigone of the Polish mathematician and philosopher, Hoene Wronski, Durutte introduces the notion of rhythmic numbers, which is the series of prime numbers and their multiples, from which, he argues, the true chromatic scale can be derived. To fend off his critics, Durutte was cleverly able to justify the importance of certain of these numbers by physiological demonstrations--three is justified as a rhythmic number, for example, since the heartbeat moves in triple time. Amongst the most original of Durutte's ideas, we learn, are his "Loi generatrice des accords" (two formulae for generating every possible chord), and a series of mathematical principles which purport to distinguish between good and bad chord sequences. Fichet proceeds by way of example to demonstrate how Durutte's notions could produce absurd results that would not even have comported with what musicians regarded as acceptable in Durutte's own time, and exposes the theorist's attempt to mask this flaw by judicious selection of self-serving musical examples.

[6] The second half of the section on nineteenth century theories of music is devoted to three theorists whose scientific orientation was physiological in nature: A-J Morel, Charles Henry, and Hermann von Helmholtz. Few pages are devoted to discussion of the first, whose theories were based on the misconception that the timpanic membrane can

only perceive one tone at a time. The ruminations of the second, whose goal was to realise our destiny in the form of the creation of a universal harmony, are similarly presented as rather absurd, with Fichet noting that it was indeed their very lack of seriousness which, although limiting their weight, had allowed them to evade systematic criticism for so long. This section of the work concludes with an overview of the writings of Helmholtz, who sought to bring together the fields of acoustics, physiology, and music. Fichet notes that although Helmholtz's theories on consonance are now obsolete in certain respects, they nevertheless form the basis of contemporary thought on the subject. For example, Helmholtz argued that different frequencies are processed by particular auditory nerve fibres in the same way as if different piano strings were attached to them, with approximately 33 fibres per semitone. It is clear that Helmholtz was at least on the right track, and the main advantage of this theory, notes Fichet, was that it explained why the ear could be insensitive to phase differences in the various components of a sound, for the perception of timbre. An overview is then provided of Helmholtz's account of consonance and dissonance in terms of beats, and his classification of various intervals and chords according to their dissonance.

[7] The twentieth-century theories covered in *Theories scientifiques de la musique* are subsumed under two categories: those founded on mathematics, and those based on physics. In the former group fall Hindemith, Schillinger, Ansermet, Information Theory, theories influenced by the advent of computer-assisted sound wave analysis, the theories of Xenakis, and the Set Theory of Allen Forte; the latter group encompasses theories based on micro-intervals, spectral music, and the work of Stockhausen. Concerned to bring an end to the confusion that hitherto reigned in musical composition, Hindemith proposed several laws of composition designed to bring an element of certitude to the discipline, while at the same time maintaining a profound belief in the total freedom of the compositional process. Like his nineteenth-century counterparts, Hindemith commenced by attempting to use the acoustical phenomena of harmonics to derive the ideal chromatic scale and provide a complete classification of musical intervals. Hindemith's approach differs from that of his predecessors in that he does not hold that the harmonic series is necessarily instantiated in the natural spectrum of musical instruments, but is more like a mathematical representation which more or less coincides with it, and he provides a convoluted algorithm for deriving the notes of the chromatic scale, which Fichet dismisses as a mere game of numbers with no scientific basis whatsoever. He then proceeds to show the internal logical inconsistency of Hindemith's derivation of a tonal hierarchy, his account of difference tones, his classification of chords with respect to their

dissonance, and his dismissal of all atonal music. Fichet concludes this section by arguing that Hindemith's approach on the whole is only speciously scientific, often based on nothing more than compositional practice, as the direct expression of human nature, as if it were as immutable as the physical nature of sounds.

[8] The next theorist examined by Fichet, Joseph Schillinger, receives a critique so scathing that one is left to wonder why his work was ever considered worthy of discussion in the first place. Schillinger is described as an obscure and mediocre composer, with a poor musical background, and in the fourteen pages devoted to summarizing his work it is demonstrated that his methods have no scientific or mathematical foundation whatsoever, despite his claim to have established the first scientific system crossing the threshold of the sanctuary of musical creation. Lovers of the great masters may be especially interested in the section describing Schillinger's noble vision to "improve" the works of Bach, Mozart and Beethoven, by recomposing them according to his compositional methods.

[9] An overview is then provided of phenomenological accounts of music, which focus upon the mental phenomena arising from the appearance of music in sounds. Ernest Ansermet, famous conductor and Swiss phenomenologist, is shown to argue illogically, inconsistently, and incomprehensibly that the energy from sound percepts is logarithmic in nature, which he argues to imply of itself that music must have a tonal center and that the fifth is of primordial importance in intervallic relations.

[10] The next section focuses on application of Shannon and Weaver's Information Theory to music, by Abraham Moles among others. The basic idea is that a musical composition is treated and analyzed into bits of information to be communicated to the auditor, and that the more structured a piece of music, the more redundancy it contains and the less original information it conveys. The main problem that Fichet identifies with this approach is that it totally ignores the subjective nature of perception, both between auditors and between epochs, and rests on the dubious assumption that the brain processes all sensory information in the same manner.

[11] Continuing the computer science theme, Fichet next describes the limited success of the attempts of Hiller, Isaacson, and Barbaud to design computer programs capable of composing music, using random number generation within the confines of programmed harmonic rules, to model the creative aspect of composition.

[12] The final two approaches considered under the rubric of mathematics are the stochastic music of Xenakis, and the set theory of Allen Forte. The former is more a mode of composition than a theory as such, and applies a formula derived for analyzing kinetic energy of gases, to allow manipulation of the degree of randomness in various aspects of musical composition. The main problems Fichet identifies with this approach are that: various degrees of order can still emerge in patterns defined as random according to the formula; that the formula was not designed to indicate whether or not a particular pattern would be perceived by humans as random; and that it prescribes randomness only for small clusters of notes and not for the way in which these clusters are then linked together by the composer.

[13] Forte's Set Theory is then reviewed, and criticized for its overly complex nature, that it not does not always provide a complete analysis of important patterns evident in atonal music, and that it can sometimes give results that do not comport with the reality of the music described.

[14] Fichet's analysis of physics-inspired "theories" of music consists of an overview of compositional procedures using micro-intervals and spectral music, as well as a discussion of Stockhausen's notion of the primacy of time as the overarching organizational principle in music. Fichet observes here that these are more a series of scientifically-based observations on music that may help to create compositions closer to naturally-occurring sounds, rather than attempts to expound exhaustive theories of music.

[15] The final section of the text is a twenty-page conclusion, which Fichet commences by noting the yawning chasm between the hopes raised by the theories reviewed and the actual progress they have made to music theory, and that this shortcoming is particularly apparent for those theories from the preceding century. In fact, Fichet concludes that the only theorist from that period to have made any real contribution to music theory was Helmholtz, with his theory of dissonance. He notes that, while notions of what is considered "scientific" have changed over the last two centuries, this nevertheless does not excuse the number of mathematical and logical errors and inconsistencies contained in these purportedly "scientific" theories of music, and that several theorists (notably Ansermet) attempted to give a scientific flavor to their writings in an attempt merely to give them some credence of rigor and certitude.

[16] Fichet then notes (without any real substantiation beyond two quotes from Bertrand Russell and Karl Popper) a movement over the twentieth century of the decreasing confidence of scientists in the value of science as a discipline, which renders somewhat surprising the hopes that certain

(unspecified) musicians place in scientific research. He then questions whether it is even feasible to ever hope for one scientific theory of music, given the very large extent to which the notion of what comprises music is so heavily culturally-mediated. He leaves open the possibility, however, that there does exist some universal conception of music, but that we are yet to discover what it is. It is at this point that Fichet reopens the possibility that scientific research in other domains--notably, the psychology of music perception--may actually be able to make some useful contribution.

[17] He concludes by noting that the quest over the last two centuries to produce a scientific account of music has largely been motivated by the search for an "ideal" music, based in nature, and declares rather patronizingly that it is regrettable that artists sometimes take themselves for researchers capable of discovering in nature immutable laws for their art form, and that it would be more reasonable for them to "find" their own music, taking into account natural constraints, but trusting in their intuition, guided by a rich cultural background, to thereby produce *une creation feconde*.

[18] By way of general appraisal, Fishet's writing style is lucid and entertaining, and the development of ideas proceeds in a logical manner throughout the text. Occasionally, however, some points are too labored (for example, in the section on computer modeling of composition, Fichet takes three pages to explain the simple point that it is inappropriate for Barbaud to run his software several times and then independently select the most aesthetically pleasing computer output to demonstrate the effectiveness of his program), and the chapter on Xenakis is at times repetitious (the point is made several times that while Xenakis' formula indicates the number of each musical phenomenon that should appear if a work is to be regarded as random, it does not indicate the exact positioning of the phenomenon with respect to its neighbors).

[19] The usage of footnotes and illustrations is informative without distracting from the flow of the text. It would have been helpful, however, if the abbreviations employed therein were more clearly defined by initially noting them adjacent to the phrase they denote. Furthermore, the reader would be better able to follow the structure of the text had section headings and subheadings been more clearly differentiated. Finally, given the author's recognition in his conclusion of the contribution that other scientific disciplines--notably psychology--may bring to understanding the nature of music, and the manifest inadequacy of theories proposed in the "harder" sciences, it would arguably have been legitimate to include in the work some analysis of research in these fields over the last century.

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