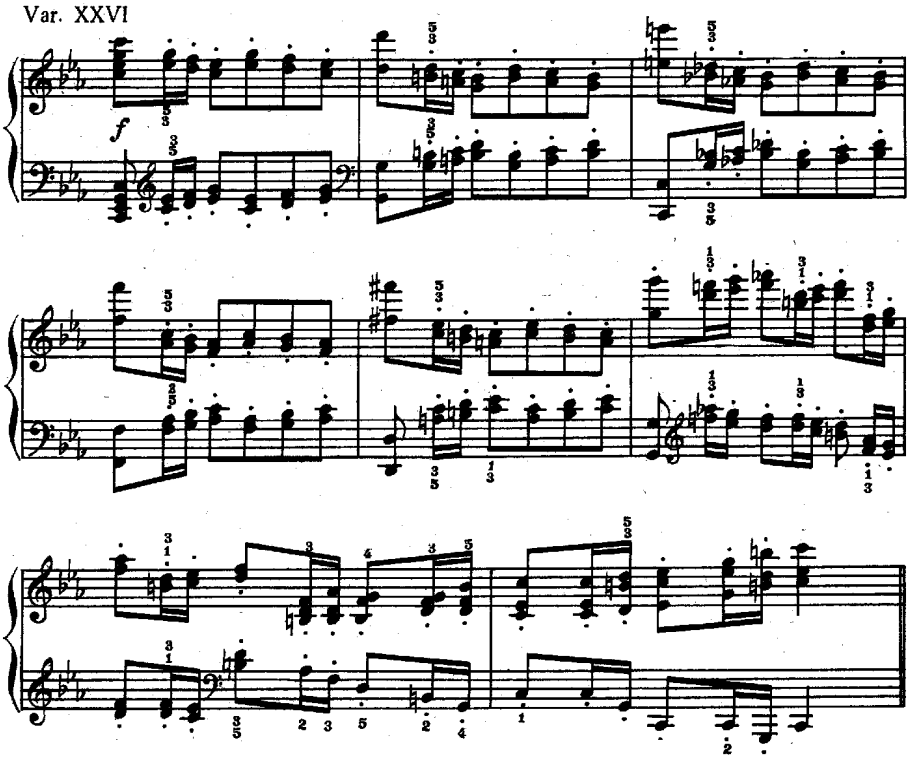
PHYSICAL PROBLEMS AND MUSIC

Matteo Magistris[1]
Ecole Centrale, Paris



INTRODUCTION

ΛΟΓΟΣ and NATURE

In many Greek tragedies of the Vth century B.C. man was considered as a foreigner who, forced by a cruel destiny, had to live in a world which hasn't been made specially for him. The word "foreigner" comes from the theory of Oracles, according to which our acknowledgement of the mysterious forces that governs the nature is so weak, that during our life we find the same difficulties a foreigner will find when he arrives in a land different from the one where he was born.

The idea of a world the existence of which is independent of us, is one of the most important points of Leopardi's philosophy. In nature there are many common events that for men are simply catastrophes. For Leopardi it is quite hard to believe that a god has created such a cruel world ("natura matrigna") specially for men, as if He wanted to show to them his love for the human being with inundations and earthquakes. For what "curvel destiny" may concern, Greek philosophers didn't even try to find a reason for our existence. As the tragical theater did the presocratic philosophy had just the aim of making people thinking about fundamental problems.

Sometimes also about political problems, as the comedies of Aristophanes. In any case, philosophy has to find good questions and religion has to propose reasonable answers.

Even if with some exemptions (Sant Agostino, Tommaso d'Aquino...) priests don't like doing confusions on this important difference. Destiny can without no doubt be considered as the limit of men's power. In a man's life some events that are against his will or just not expected may happen.

Greeks call the origin of these uncontrollable events "$\tau\upsilon\chi\eta$", a world which comes from the verb "$\tau\upsilon\chi\alpha\grave{\iota}\nu\omega$", "to happen" or "to appear". Writers of the Middle Ages, like Boccaccio, are quite optimistic about $\tau\upsilon\chi\eta$ and they say that "homo" is "faber fortunae suae".

[1]E-mail: magistma@cti.fr

Aeschylus would probably not agree with them and focalize his attention on "$\tau\alpha\ \delta\epsilon\grave{\iota}\alpha$" ("terrible things"), like the war between Persians and Greeks seen from the point of view of the Persian "$\beta\alpha\sigma\iota\lambda\iota\alpha\varsigma$". A tragedy where it is possible to find easily all these topics is "Oedipus King" of Sophocles.

As a foreigner has to study a plan of the city to understand which way is the best one to reach a place, Oedipus has to investigate his own life to understand wether he is a glorious or a miserable man. He is not able to change his life, he can only try to understand which "mask" $\tau\upsilon\chi\eta$ gave him. The task of Oedipus is the Socratic "$\gamma\nu\omega\Theta\iota\ \sigma\epsilon\alpha\upsilon\iota\tau\upsilon\nu$" and his enemy is the doubt, considered worst than the worse truth.

The typology of hero presented by Sophocles is probably strange to us, because we are used to have heroes able to change the result of a battle or to struggle bravely against a big number of enemies, like in the "Chanson de Roland". Oedipus neither kills nor saves anybody during the tragedy, he just wants to know ("sapere aude!") and since he succeeds in his investigation he becomes a perfect Greek hero.

The only weapon he can use to defend himself from the enemies he finds on his way (the Sphynx, for example) is his reason.

This precious instrument of the human being has been called "$\lambda o\gamma o\varsigma$" by Greeks who considered it a present given by Gods.

The word "$\lambda o\gamma o\varsigma$" is full of meanings and alone could explain the Greek interpretation of rationality. In fact it means not only "reason" but also "word" and hides in itself the strong relationship between capability of understanding and capability of communicating. From this point of view men are like foreigners in their life: the nature where they live speaks to them about their destinies (with oracles, birds flying...) but since the language it uses is difficult and ambiguous only heroes can solve the enigmas with their "$\lambda o\gamma o\varsigma$".

PHYSICS

The IMPORTANCE of a RATIONAL LANGUAGE

The same problems Oedipus found while doing a "$\sigma\chi\grave{\eta}\pi\tau\iota\varsigma$" ("investigation") of his past have been present during the historical development of science.

One of these difficulties is the not always obvious relationship between cause and consequence. For example, if we know that Oedipus killed his father we can say that he was a criminal. But if we don't know anything about the death of his father, he would be a criminal in any case, but we would treat him as a respectable man. It means that the consequence of his murdering (his miserability) is present, but since we don't know the cause (he is a killer), we don't see it. It is possible to do analogous considerations about the gravitational attraction.

Nowday we know that an apple attracts a peach because of a gravity and with sofisticated instruments we could be able to notice this weak attraction. The fact is that we couldn't notice it if a physicist didn't see that the earth attracts the moon. The attraction between planets is an easily observable phenomena, and since any corps is attracted by a planet (the earth) our rationality allows us to generalize the event and to think that the same force will make an apple attract a peach.

Without knowing this cause, nobody probably would have discovered this last phenomena. The easiest but nevertheless dangerous step of this process is the generalization of phenomena.

Sometimes it is not simple to understand when we are allowed to suppose that a law true for a particular event is true also in another context. To solve a physical problem we need in any case some "true" laws, and physicists have been looking for formulae hoping that in nature at least some general rules exist. This conviction has its origin in the observation of natural events, like seasons.

A general law is a law which is true for more than one event: in the word "general" there is the concept of "repetition", "rhythm". The first strong link between Physics and Music is "rhythm", a natural concept which can be rationally defined as "succession of periodical events".

To define a general law physicist need a language; at first words are enough to give a qualitative idea of an event. It is the case of the first classifications of earthquakes where the intensity was established by a description of the consequences on the landscape.

The development of a national interpretation of natural phenomenas is lined to the development of mathematics, which has been adopted as official language because of its quantitative precision, a gravity which is necessary to describe periodical events.

For example, if we want to give an emotional image of a storm as an event that can't be repeated and that everybody lives in a different way, artistical languages would be more convenient.

Is this emotional image is given by the idea of little drops of water that fall down rhythmically and constantly, mathematics or at least geometry is needed.

A musician world exhibits this rhythm with repeated notes played by strings (Chopin's Concert for Piano and Orchestra n.2) and a writer with the repetition of the word "piove" ("it rains") in the same poem (d'Annunzio).

In any case the number of notes in each measure is fixed and constant, and even in the poem the intensity of the rain we imagine is linked to the frequency of "piove" in the text.

Sometimes the physical theory is so complex that powerful instruments of mathematics are required.

In this case many pieces of information about a physical event are contained in the definition of a mathematical operations themself, for example the concept of angular momentum and vectorial product.

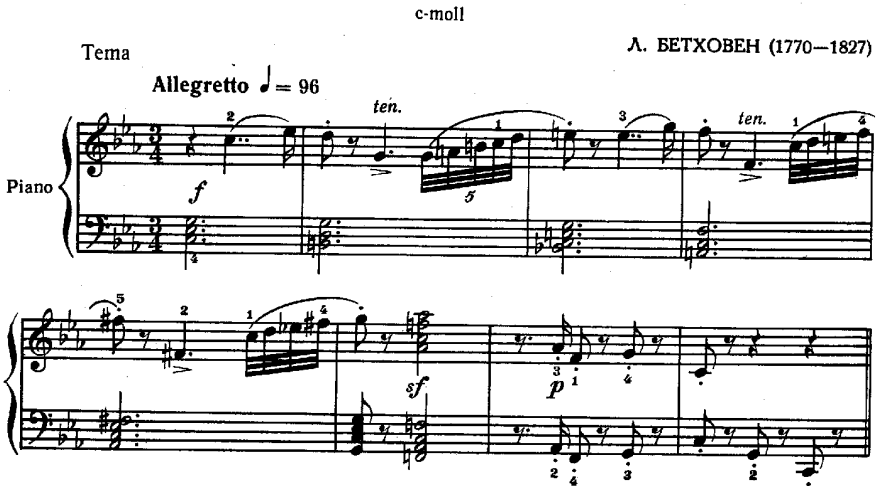
The mathematical language and physics are so connected that it is almost impossible to understand where the border between them runs.

MUSIC

BEETHOVEN: ΛΟΓΟΣ and ΠΑΘΟΣ

In many of Beethoven's works there is a sort of sense that makes his music deep and meaningful. In the sonata op.31 n.2 (composed by Beethoven when he wanted to commit a suicide and considered a testament of the German composer) the calm of the second movement describes in some way the power of nature, which continues on his way without even noticing that a man is struggling against death.

An impression of optimism comes from the simplicity of the theme, whose intensity increases since its first three notes. Beethoven shows his faith in nature presenting it with an optimistical tonality (Si-bemol major), something that could surprise us because it means that the composer thought about his own tragedy (he was becoming dumb) as a necessary element of a perfect and wonderful nature. Probably when he wrote his 32 variations on an original theme in do minor the same idea of a hero struggling his own battle under the control of an ineluctable destiny was in his mind.



The theme is a declamation of a man who wants to impose his will but this man is not allowed to do all what he wants. As Oedipus couldn't change his destiny, this new hero can impose himself just until a particular moment when an external event happens (it's the only "sforzata" of the theme),

then he recognizes his limits and finishes his declamation with a low voice of submission (the last measure of the theme is compassed by notes "piano" and "staccato").

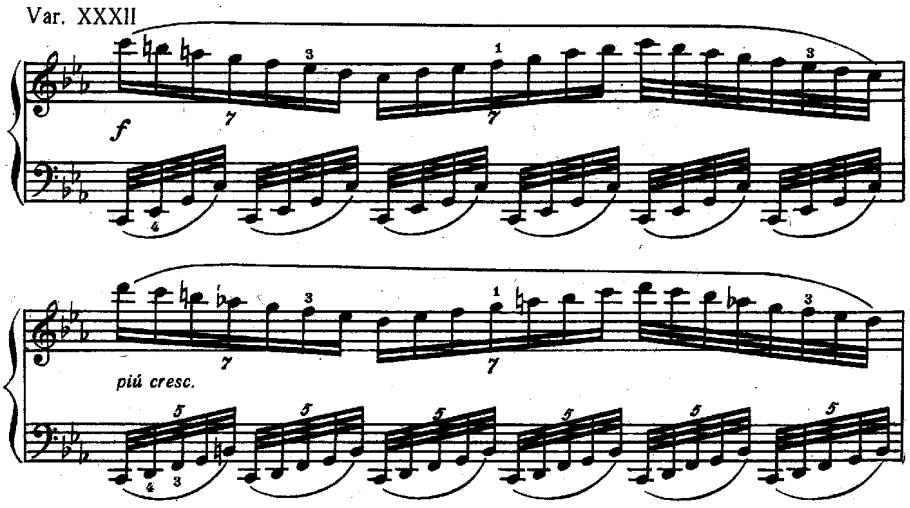
In the Greek tragedy destiny was so strong and severe that men's task was to understand its will (with oracles or natural phenomena) and accept it blindly for two main reasons. The first reason is that whenever they did something against its will they were punished. The second is that in any case destiny was cruel but equal and rational: it was not a case that the Sphynx didn't kill Oedipus, and its rationality arises from the criterion it had to decide who had to die.

Also Beethoven's nature is severe and equal, like the one of physicists. In particular, the nature that observes and controls his hero is even rational and the structure of the "theme with variations" is a musical representation of its periodical character. Like physicists did, Beethoven needed a mathematical language to describe such a rational destiny, and its music is full of geometrical details. The first step is to remark that the number "thirty two" is not a case.

The magic number "two" seems to be the symbol of the power of rationality; it appears in classical physics (energy, intensity, gravitational, attraction...) as the belief that the easiest formulas are the best ones to describe nature, like in classical music the simplest melodies are the best ones to describe feelings.

The theme is composed by two parts (an increasing one and a decreasing one) and even the harmonical structure of each semiphrase is composed by two statements (tension and resolution). As physicists do when they consider a new model, Beethoven begins to analyze the theme with all the logical and musical instruments he had and to find all the possible consequences of the smallest detail, always respecting the structure of the melody, which is the hypothesis of his work. It may happen that physicists have to find more sofisticated instruments of mathematics to describe a theory. The intensity reached by Beethoven in the last variation is so high, that he has to find a language more sofisticated than the one used by Mozart or Haydn to go further.

At the beginning the elementary part of rhythm is divided into two events, or notes. In the middle of the piece, the events become three and sometimes four. In the last variation the classical numbers are not enough, and we find seven events or even seven against eight, which means to divide every elementary part into fifty-six events.



At this point, Beethoven himself has to stop. The events become four and, in the last measures, they are just two. Probably Beethoven could continue his work, since the theme is so rich that even with classical instruments it is possible to imagine other variations.

But the importance of Beethoven's work is not only on the contents of his music, but also on the problems he posed. We have to wait until Chopin's "rubato" to resolve the problem of the seven against eight. The innovations Chopin has brought to musical language are cause and consequence of the changement of the interpretation of nature at his fine and of the arrival of a new movement in literature: the romanticism.

Since such radical changes in the language used by physics have not been seen since Newton, may we suppose that our scientific interpretation of nature has not changed during the last centuries?