

The duality between love and math

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The mathematician Edward Frenkel has directed, in collaboration with Reine Graves, an astonishing film, "Rites of Love and Math", homage to "Yûkoku" or "Rites of Love and Death" by Yukio Mishima. Aesthetically perfect, it will intrigue those who think of mathematics as the absolute opposite of art and poetry. It will provoke others...

"Rites of Love and Math" is a silent film, which consists of several chapters. There are written texts and the action takes place under a calligraphy painting by Edward Frenkel of a word written in Cyrillic that follows the shape of the mathematical sign of integral. This word is "istina" which means "truth" in Russian, in the sense of "absolute truth". It is different from the word which means truth in the ordinary sense, "pravda", familiar as the name of the newspaper of the Russian Communist Party.



The scene where the action of *Rites of love and Math* takes place under the sign of truth.

In other words, the action in the film takes place under the sign of absolute truth. The painting seems to indicate that the truth follows a winding path (that of the sign of integral), or else should one see here the truth being integrated? Both of these interpretations make sense, but the first one is more likely. When a mathematician finds his first proof, it is a moment of total joy, but it is rarely crystal clear. It is often tortuous, as in the painting by Frenkel. It is the subsequent research that refines and gives it its ultimate beauty. Every mathematician is in fact searching for the beauty as much as the truth.

The tribute to Mishima

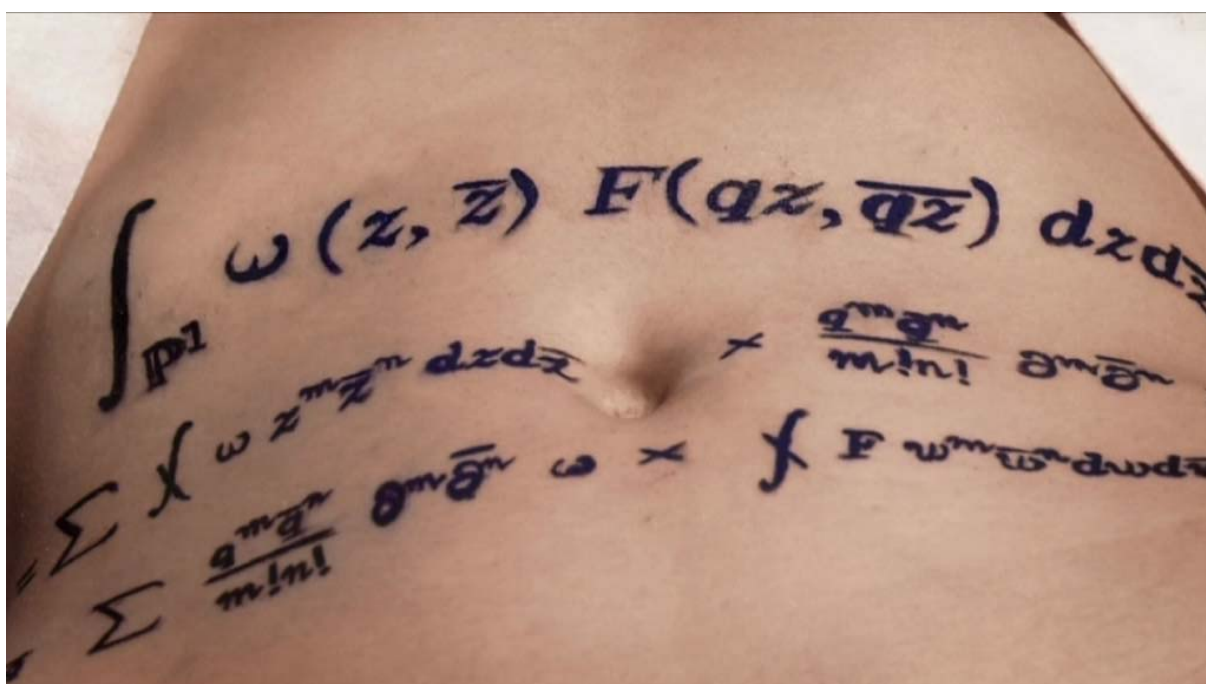
The film follows the structure of “Yûkoku” which foretold the suicide of Yukio Mishima (1925 – 1970) by seppuku (also known as harakiri). Mishima has directed it in 1966 at the age of 41, just like Frenkel! It unravels under another painting carrying the word “sincerity” in Japanese. The colonel (played by Mishima) is torn between two loyalties, to the Emperor and to his friends who stage an unsuccessful coup d’état, and he sees suicide as the only honorable way out. He returns to his wife to bid his final farewell which is followed by a very pure and stylized love scene. He then commits suicide by disembowelment in a scene of frightening realism, unadvisable to sensitive people to watch; his wife follows him in death. A notable difference is that, in Edward Frenkel’s film, the heroine survives. We hope nothing bad will happen to the director who, despite coming from the western tradition, has so many points in common with Mishima.



The scene where the action of *Yûkoku* takes place under the sign of sincerity.

The intrigue

In Frenkel's film, the intrigue is different. At first glance, it seems puerile. After years of hard work, a mathematician discovers a Formula of Love. It will bring people eternal love, youth, and happiness. But later he discovers, to his dismay, that the formula could also become, if used in the wrong way, a weapon against Humanity. And so Forces of Evil are now after the mathematician, intent on finding him and making him divulge the formula by any means. They want to take possession of the magic powers of his formula and misuse them in order to achieve their sinister goals. The Mathematician knows that nothing will stop them. Having resolved not to let his formula fall in the wrong hands, he knows that his days are numbered. To preserve the formula, he decides to tattoo it on the body of his lover before killing himself. The use of the belly of a woman for the tattoo is not accidental. The suffering that the tattooing causes her as the mathematician engraves the formula on her body reminds us of birth pangs. So, unlike the suffering of the wife of Mishima's character, the suffering of mathematician's lover leads to a birth.



The formula tattooed on the belly of the mathematician's lover. French speaking people will notice the indices m (aime = love) and n (haine = hate).

Echos

This formula which can lead to good or evil comes to echo the questions which have troubled scientists for a long time. The most well-known example is of course that of nuclear energy, which has some benefits, but can also destroy humanity. This problem seems to be far away from mathematics at first glance. But it's not in fact, because the computations involved in the making of these machines (civil or military) are dominated by mathematics. One could, as Godfrey Hardy (1877-1947), hide behind a distinction between pure and applied mathematics. In this sense one could characterize the latter as impure! But actually, this distinction is illusory and depends on the time period. The theory of numbers, admired for its uselessness by Hardy, is today the basis of cryptography, used for diplomatic and military purposes, and even for everyday banking needs. There is nothing to be gained by putting mathematicians against each other, small or big, pure or applied. It's not them who create applications. To refuse doing mathematics amounts to committing suicide as a mathematician... and even as a

human being. This symbolic death makes one think of the vocabulary of another aesthete of mathematics, Paul Erdős (1913-1996), for whom the word “dying” meant “stopping to do mathematics”. The mathematician dreads this first death, after which he will no longer be productive, and can only talk about his passion, without living it.

Empire of signs

In Mishima's film, the colonel dies, torn between different loyalties, on the altar of honour. Some French military men have experienced a similar situation at the end of the war in Algeria, torn between their commitment to the state and to their comrades in arms who became putschists. Their duty was to renounce those friends, but can we imagine a man of honour doing this? Unlike Mishima's colonel, few had ended up bringing death to themselves. Their death took the form of renunciation of their *métier*.

In the film by Edward Frenkel and Reine Graves, the mathematician dies on the altar of truth, but is in fact survived by his lover carrying his formula. She personalizes here mathematics itself, which will survive us, at least we hope so. The death of mathematician, like those of the French colonels mentioned above is rather a renunciation. This sign remains mysterious and offers multiple interpretations.

Edward Frenkel



Edward Frenkel

In the mathematical research of Edward Frenkel, symmetry and duality are of great importance. They are related to the Langlands Program which aims to establish a bridge between the theory of numbers (arithmetic) and representations of certain groups. This very abstract subject actually has applications, for example in cryptography, where groups over elliptic curves are being used. The cryptography is the area that could have applications both harmful and useful. If the idea of duality is so important to Edward Frenkel, one could ask whether he sees a duality between love and mathematics as the title of his film would suggest. His answer to this question is clear. For him, mathematical research is like a love story, and he has tattooed his formula on the body of a woman, representing a universal standard of beauty.

Reine Graves



Reine Graves

After working as a model, Reine Graves has directed a number of short and medium length films, a format that she is fond of. Being a photographer, she has mastered the space particularly well, that is to say the frames. Has her being a model also allowed her to control time? Hard to say, but the rhythm of the film is perfect.

For this homage to Mishima under the sign of absolute truth, rather than honour, Reine Graves chose to film with a camera of high definition with crude light, using makeup that does not hide the imperfections of skin. The truth does not permit anything artificial. Likewise, the acting is simple. Excellent choices.

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