THE MAIN CAUSE OF MAN-MADE DISASTERS

V. P. ROMBAKH

Catastrophes Prevention Research Laboratory

Edmonds, WA USA

A man-made disaster is a sudden destruction or damage to a structure or device created by man. Particularly dangerous is a catastrophe when people are killed or injured.

According to Lee Davis, a well-known American catastrophe researcher, man-made disasters due to the human factor, which manifests itself due to Stupidity, Negligence, and Self-Interest.

I believe that there are two manifestations of the human factor, the first of which is due to ignorance of the laws of nature. The second one is the neglect of these laws when they are discovered.

Everyone who designs creates and operates structures, and devices must know the laws of nature at the level of scientific achievement. Just as a virologist must report about a previously unknown dangerous virus that they have discovered, a scientist who discovered the law of nature, neglect of which will lead to disaster, is also obligated to report the discovery.

The law of destruction of a solid body has been described in the book "Non-invasive monitoring of atomic reactions and its application," published on the website

https://catastropheprevention.com/book-%22non-invasive-%22.

The best example of the transition from ignorance to the neglect of the discovery of the law of nature, which leads to disaster, I will demonstrate in the case of the discovery made by Benjamin Franklin.

What do we know about him?

Grateful America calls Franklin one of the Founding Fathers, who signed all three of the most important historical documents that underlie the formation of the United States of America as an independent state: The Declaration of Independence, the US Constitution, and the Versailles Peace Treaty of 1783.

Fig. 1

Fig. 3

Fig. 2

Fig. 4

Fig.5

You see, in Fig. 1 an engraving is written in 1777 in Paris, according to which we can imagine the image of this man. A plaque on Franklin's grave shown in Figure. 2, contains one sentence that fully characterizes its unique role in the lives of people of subsequent generations:
“HE TORE FROM THE SKIES THE LIGHTING AND FROM TYRANTS THE SCEPTRE.”
Photos of engravings Fig. 3-Fig. 5, performed by various artists, are intended to show that crucial experiments based on which Franklin proved the unified nature of electric discharge and lightning.

Franklin's electrostatic machine display at Franklin Institute museum.

Fig. 6

The artists who did not know physics and did not work with an electrostatic machine could not have imagined that the experiment they depicted would have killed Franklin. The Franklin-built electrostatic device is shown in Fig. 6. This machine, equipped with a Leyden jar capacitor or flat capacitor called the Franklin board, he invented, allowed to create a spark at a voltage of more than a thousand volts. Consequently, Franklin was aware of the danger. He knew that the nature of lightning and sparks is identical.
That means that he experimented with researching the possibility of creating a lightning rod, and the thread was grounded. J. Priestley confirms this fact, noting that the silk thread was connected to the Earth with a wet rope. Moreover, the experiment was carried out before approaching thunderclouds.

This conclusion does not detract from the role of Franklin's experiment. It illustrates his brilliant foresight. If you look closely at Franklin's device, you will see that the axis with which the glass ball rotates goes inside the ball. It is actually a prototype of the Van de Graaff electrostatic generator that, after 160 years, he used to obtain a voltage of one million volts!.

Fig. 7

The three photographs shown in fig. 7, were made on January 28, 1986, during the launch of the Challenger shuttle and 73 seconds after it.

The cause of the disaster was revealed by Richard Feynman, who has never designed the rockets. Feynman asked questions to understand why the catastrophe, which had an estimated probability at 1:100000, has occurred.

He described his search for a cause in the book "What do You Care That Other People Think?" Feynman concluded that the reason for the disaster was damage to the o-ring caused by its cooling and increased fragility. He demonstrated his conclusion by throwing a fragment of a ring into a glass of water in with floating pieces of ice, as shown in the photograph, Fig. 7b.

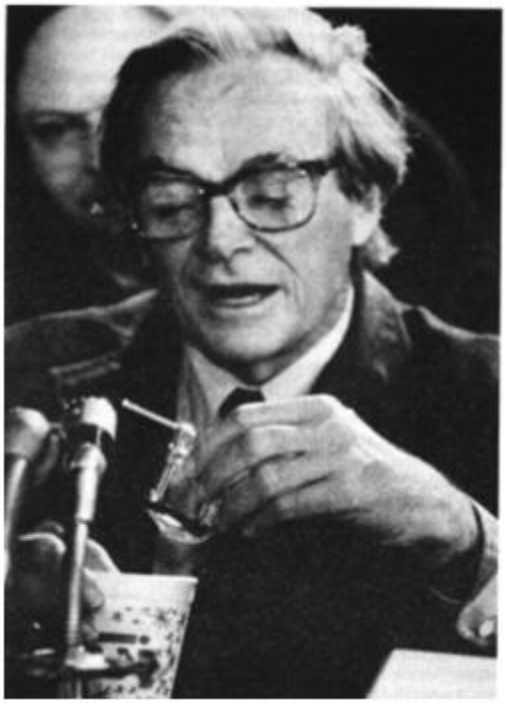

Fig. 7b

I did not find in the literature on the causes of disaster any references to this book by Feynman. But he writes in it about the use of mathematical equations, probabilistic methods for predicting the technical condition of rocket elements, bridges. He paid particular attention to computer programs, warning that a computer program should be created based on real experimental measurements. He wrote, "You know these programs: GIGO, Garbage In, Garbage Out."

Feynman was, at that time, a famous scientist, a Nobel Prize laureate for the creation of quantum electrodynamics, which is the most accurate physical theory today. He gave a lecture on December 29, 1959, thanks to which today we are reaping the benefits of nanotechnology. He created a new course in physics, played the drums, solved the pin code of safes, and, has perfectly mastered the mathematical apparatus, stated that mathematics was not a science. When some mathematicians were outraged, Feynman said that love is not a science either, but that does not mean bad.

These two examples illustrate that only the use of physical laws offers ways of finding the cause of the disaster and its prevention.

Today we must understand what role mathematics plays in the prevention of technogenic disasters while not being a science. But for this purpose, we need to solve some simple problems in mathematics, physics, and technology.

MATHEMATICS AS LINGUISTICS, PHYSICS, AND TECHNOLOGY

I will take advantage of one event that happened almost 170 years ago with the famous physicist William Tomson (Lord Kelvin) and his students.

Once, he had to cancel his lecture. He wrote to students on the blackboard about this, “Professor Tomson will not meet his *classes* today.”

The next day he came to the audience, there were no students, but his message remained on the board: “Professor Tomson will not meet his ***lasses*** today.” He smiled and also left. The students came to the lecture on the third day. There was no professor. The same message has been preserved, but as follows: “Professor Tomson will not meet his *asses* today.” The lecture took place only on the fourth day. The students greeted the professor with applause since he outplayed them.

This example demonstrates the effect of minimal changes when one character (letter) is deleted in linguistics.

This funny story is given to recall the role that the works of Thomson, Maxwell, and Feynman, undeservedly forgotten, have played in the theory of strength. Today, more than a hundred opinions are known, called theories, but none of them are based on an experiment. Moreover, numerous tests have refuted all theories based on classical mechanics. The exception is Maxwell's work, published in 1850, but it is devoted to linear mechanics.

Mathematics, like any other language, only exists because it is applied in practice. In this case, the information recorded by the characters becomes significant.

Let's see the equation A + B = C. What is encrypted in this equation?

Example 1. Student A put 4 pencils on the table; student B put 5 more pencils.

How many pencils are on the table? Solution C = 4 + 5 = 9. The task makes sense. The result will not change if you change the action sequence.

Example 2. A-pour water into the pool, B-jump into it from the tower. The result will change if you change the action sequence, and it will become catastrophic.

Example 3. $\alpha = l + l^2 + l^3 + l^4$

Find α for $l = 2$. Solution $\alpha = 30$

Example 4. $\beta = l + l^2 + l^3 + l^4$

Find β for $l = 2$ m. *The task does not make sense.*

Example 5. Imagine that a gynecologist writes in his report: the pregnancy of patient A is four months, the pregnancy of patient B, which came after her, is five months, the combined pregnancy is nine months.

I understand that you are outraged. The task and its solution are devoid of common sense, but mathematics is impeccable: 4 + 5 = 9. This task hurt no one. And I propose to solve two more problems in mathematics. You can quickly solve these problems.

So, you are convinced that mathematics is the language used by physicists, but the equation only makes sense if its members are measured parameters or parameters calculated based on measurements.

I offer you four tests with a choice of answer. It will be an examination of existing theories of strength, but not of those who use them. I ask you to give your answer to the question before you familiarize yourself with my version.

Fig. 8

Task number 1

A 4.8 m long crack formed in the API 5L X46 oil pipeline (Argentina). Two windows are cut out to investigate the cause of destruction. The metal underwent cyclic deformation of tension and bending. Theoretical study of experimental results based on the use of the Paris-Erdogan formula

$$\frac{dl}{dN} = C\Delta K^n \text{ (1).}$$

Here *dl* is the elongated cracks in meters (m) with an increase in the number of cycles *dN*, *C* is the proportionality coefficient in (m/cycle), $\Delta K = K_{max} — K_{min}$ is the change in the stress intensity factor (SIF), the dimension of which is $Pa{\cdot}m^{1/2}$, *n* is an exponent.

As a result of the calculations, the following values were obtained $n = 6$, $C = 3.318{\cdot}10^{-15}$ m/cycle.

Question: How many mistakes were made in the study?

1. There are no errors,
2. One,
3. More than one.

Let me consider the solution of the proposed problems.

Task number 1

I draw your attention to the fact that, in solving this task, we play the role of experts who must answer the question: Is the cause of the disaster found correctly? We have no right to make a mistake.

The Paris-Erdogan equation was proposed based on the Irwin hypothesis published in 1957. Irwin proposed a mechanism for the destruction of a solid and a method for analyzing it based on a new parameter called the stress intensity factor.

I draw your attention to the fact that at this time, the following were developed:

classical, relativistic, and quantum mechanics; classical and quantum electrodynamics, the theory of gravity, based on which quantum theories of chemistry, solids, optics of electronics, and even biology already existed. Nuclear power plants worked, and a satellite of the earth flew the orbit.

We all must remember that Newton laid the foundations of mechanics almost 350 years ago. You will probably be surprised that it would be about him.

Newton's second equation $F = ma$ is studied in the eighth grade of the school, but Newton wrote it like that $a=\frac{F}{m}$ (1),

where a body acceleration, F force, m body mass.

Newton believed that mass does not change, i.e., m = constant.

In this case, the acceleration is directly proportional to the force. Newton could measure force and mass, but the acceleration had to be calculated. Galileo has done before him. He wrote

$$a=\frac{v_2-v_1}{t_2-t_1} \quad (2),$$

where v_1 is the speed of the body at time t_1, v_2 is the speed of the body at time t_2.

But he could not measure speed, and he could measure only the path s traveled. Therefore, he wrote down $v=\frac{s_2-s_1}{t_2-t_1}$ (3).

But it was necessary to measure time. So, Galileo invented the clock.

Newton wrote the equation of speed in the form

$$v=\frac{s_2-s_1}{t_2-t_1}=\frac{\Delta s}{\Delta t}; \qquad a=\frac{v_2-v_1}{t_2-t_1}=\frac{\Delta v}{\Delta t}$$

He understood that the movement with a constant speed practically does not happen. But if you choose a very small interval, then the speed can be considered constant. The smaller the interval, the more accurate the law! Therefore, Newton directed time to an infinitely small value, but it remains greater than zero.

$$v = lim_{\Delta t \to 0} \frac{\Delta s}{\Delta t} = \frac{ds}{dt} \quad (4),$$

where Δs is the distance traveled in Δt.

The mathematical equation of acceleration had the form

$$a = lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} = \frac{d^2 s}{dt^2} \quad (5),$$

where Δ*v* is the change in speed over time Δt.

Newton knew that it was impossible to create constant acceleration in practice. But he concluded that Earth's gravity creates constant acceleration. Newton's experiment of dropping bodies in a glass tube, from which the air was pumped out, showing that the feather and the lead ball move with the same acceleration is well known, but the legend that the law of gravity was discovered thanks to the falling apple still exists. Newton calculated that the acceleration of free fall on earth is 3600 times greater than the acceleration of the moon, and the radius of the orbit is 60 times greater than the radius of the Earth. Hence the ratio of accelerations is inversely proportional to the square of the distance. Besides, Newton knew Kepler's laws well. Cavendish has experimentally confirmed Newton's equation. The Law of Gravity was recognized after the discovery of the planet Neptune.

So, we write next to the equation of Newton (6) the Paris-Erdogan one (1).

$$\frac{dv}{dt} = \frac{F}{m} \quad (6) \text{ and}$$

$$\frac{dl}{dN} = C\Delta K^n \quad (1)$$

n = 6, C= $3.318 \cdot 10^{-15}$ m/cycle.

1. The mathematical similarity is obvious, but we are interested in physics, not mathematics. We list the errors of equation 1

The number of cycles cannot be less than one. Therefore, the crack growth rate cannot

be considered as a derivative. It is a mathematical error, but it does not have serious significance. Four other differences are of fundamental importance.

2. Newton's equation is written based on an experimentally established relationship between the left and right sides, while *C*, *K*, and *n* were not experimentally measured. ***Therefore, the relationship between the rate of crack formation and SIF has not been proven***.
3. The dimension of the left side of the equation (meter) coincides with the dimension C. Therefore, the second factor must be dimensionless,

   but by definition, its dimension in the equation is Pa^6m^3.
4. The numerical value of the coefficient of proportionality is obtained as a result of the arithmetic division, but not based on measurements of ***the crack length, which is comparable with the diameter of the atomic nucleus.***
5. ***The estimated accuracy of C of up to the 18th digit is inaccessible and meaningless due to the uncertainty of the momentum***.

   So the correct answer for this task is 3.

I realize that for specialists who use stress intensity factors, this conclusion could mean a tragedy. But it is the fate of scientific discoveries. I think a few of you know about the historic Paris trial of a man who believed Franklin and built a lightning rod. *Robespierre* was the prosecutor; *Marat* was the lawyer, and he won the case. We do not know what arguments Marat has brought up, but he had enough examples. Every year in Europe, the domes of cathedrals and churches burned, for these were the tallest buildings.

Task number 2

Boeing 737-200, USA, April 28, 1988

Boeing 737-300, USA, April 1, 2011

Fig. 9

The catastrophic destruction of two fuselages, when the aircraft have managed to land, is shown in two photographs.

Task.

Please evaluate the energy spent on cracking 1.5 m in the Boeing 737-300 fuselage, knowing that the thickness of aluminum is 1.02 mm.

1. Less than one joule,
2. More than 10 joules, but less than 100,
3. More than 100 joules.

For example, a stone of 1 kg at the height of 1 m has an energy of 9.8 joules; when walking 1/4 mile, a person spends about 25 calories (104.5 joules).

Estimating the energy sufficient to break is the most critical and complex problem in strength theory. I did not see the works where it was calculated based on the experiment.

At present, four theories of strength are known, but the fifth one, not commonly accepted, I consider the most accurate one, which is called the Theory of Mor.

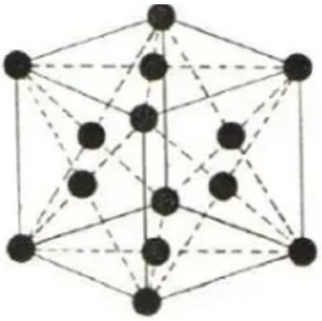

Fig. 10

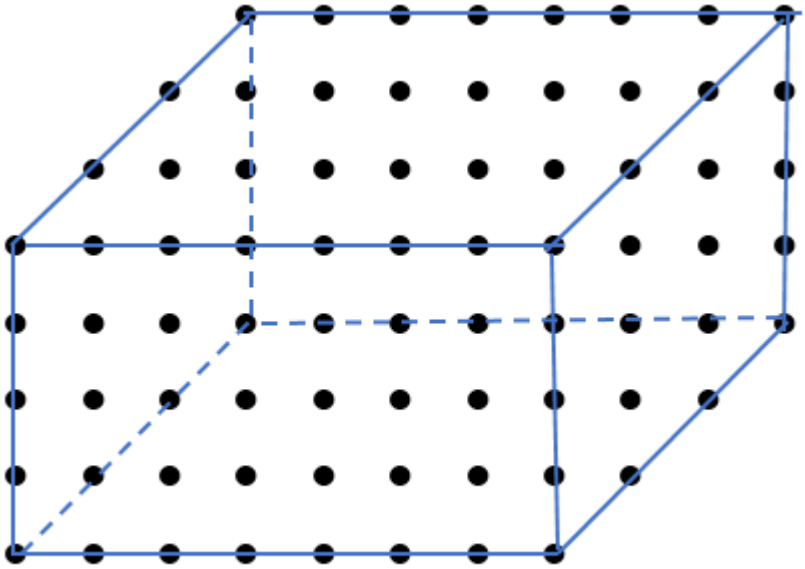

Fig. 11 a

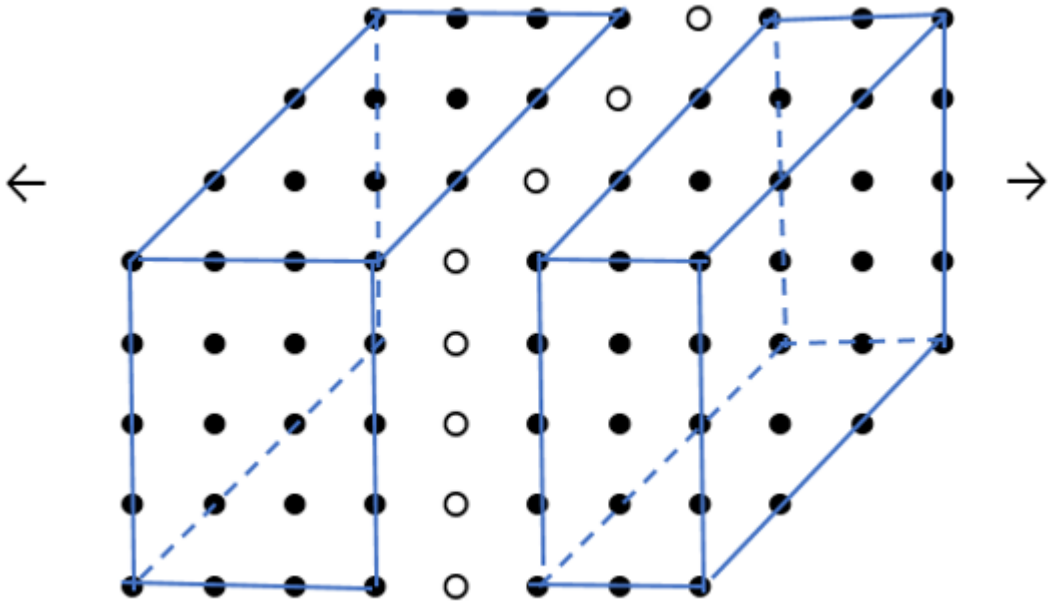

Fig. 11 b

The fact that there are five of them indicates that none of them allows predicting where, when, and which crack can form.

You would hardly believe me that in 5 minutes we will evaluate the energy spent on the formation of a crack that will show which solution is the right one.

Figure 10 shows a crystalline cell of aluminum.

Figure 11 shows a cube of aluminum consisting of 128 atoms.

Figure 11 b shows the breaking of the crystal under tension.

Twenty atoms, shown as empty circles when torn, will remain on the right or the left surface, and a crack will form between the atoms, but most likely, these atoms will simply evaporate. The sublimation energy makes it possible to determine the binding energy of aluminum atoms. Today we know that breaking one bond between aluminum atoms requires energy $\varepsilon = 3.34$ eV $= 5.35 \cdot 10^{-19}$ J. In our example, 20 bonds are broken. Consequently, 66.8 eV was consumed.

Now we need to calculate the number of atoms on the surface of a crack having a length $l = 1.5$ m, the thickness $h = 1.02$ mm $= 1.02 \cdot 10^{-3}$ m, and a crystal lattice constant $a = 4{\cdot}05 \cdot 10^{-10}$ m

We will use the formula

$$U = \frac{lh\,\varepsilon}{a^2}$$

The numerical value of the energy is $U = \frac{1.5 \cdot 1{,}02 \cdot 10^{-3} \cdot 5.35 \cdot 10^{-19}}{(4.05 \cdot 10^{-10})^2} \approx 5 \cdot 10^{-4}$ J.

Such a minimal energy value required for the formation of a crack in the fuselage could be perceived as an error in the calculations, but this is not an error (!).

Here it is necessary to recall that mathematics, in this case, is the language of quantum mechanics, but not a classical one, in which there are no such concepts as a photon, electron, atomic reaction. Quantum mechanics consider classical mechanics as a special case. It means that considering the process of crack formation from the position of classical mechanics, the authors do not pay attention to some essential features. Now we will consider one of them.

For example, an apple weighing 100 grams, having fallen from a height of one meter to the surface of the wing of an airplane, will transmit to it an energy of 0.98 joules, which is almost two thousand times larger than the found value, but it will not destroy the airplane. Why?

The current most four prevalent energy theories of strength will consider the stress concentrators as a cause of the destruction.

But none of these theories have parameters of time and power.

Suppose an apple's impact time of one-thousandth of a second. The speed of acoustic waves in aluminum is 6000 m/s. Consequently, during this time, acoustic waves will propagate over 6 meters. One cubic meter of aluminum consists of $6.02 \cdot 10^{28}$ atoms. That means that the metal coating of the aircraft consists of $10^{26} \div 10^{27}$ atoms. An acoustic wave that occurs at the moment of impact is absorbed by metal atoms or scattered, causing an increase in temperature.

An increase in temperature will also be insignificant, but everyone knows what danger a bird poses to a flying airplane. Now imagine that a meteorite weighing one hundred grams flies to the Moon at a speed of 10 km per second. The energy transferred by the meteorite will be 50 MJ, which corresponds to 12 kg of TNT, and the impact time will be reduced and will lead to a local increase in explosion power and the formation of a crater.

Now we will return to the equation of Paris - Erdogan.

$$\frac{dl}{dN} = C\Delta K^n \quad (1).$$

$$\frac{dl}{dN} = C\left[\left(\frac{1-f}{1-R}\right)\right]^n \Delta K \frac{\left(1-\frac{\Delta K_{th}}{\Delta K}\right)^p}{\left(1-\frac{K_{max}}{K_c}\right)^q} \quad (1^*)$$

Please see below advertisement for another equation:

Task 3

How many errors does this equation contain?

1. Only mathematical ones, which does not play a significant role.

2. The NASGRO equation is identical to the Paris-Erdogan equation and has no physical meaning.

Application of the NASGRO equation, derived by Forman and Newman from NASA, de Koning from NLR and Henriksen from ESA, of the general form (AFGROW, 2002; NASGRO, 2006):

$$\frac{da}{dN} = C \cdot \left[\frac{(1-f)}{(1-R)} \cdot \Delta K \right]^n \cdot \frac{\left(1 - \frac{\Delta K_{th}}{\Delta K}\right)^p}{\left(1 - \frac{K_{\max}}{K_c}\right)^q} \tag{1}$$

has significantly extended possibilities of describing the crack growth rate tested according to the standard (ASTM E647). The coefficients stand for:

a – crack length [mm],
N – number of load cycles,
C, n, p, q – empirical coefficients,
R – stress ratio,
ΔK – the stress-intensity-factor (SIF) range that depends on the size of the specimen, applied loads, crack length, $\Delta K = K_{max} - K_{min}$ $[MPa\sqrt{m}]$,
ΔK_{th} – the SIF threshold, i.e. minimum value of ΔK, from which the crack starts to propagate:

$$\Delta K_{th} = \left(\Delta K_1 \cdot \left(\frac{a}{a + a_0} \right)^{\frac{1}{2}} \right) \cdot \frac{\left[\frac{1-R}{1-f} \right]^{(1+R \cdot C_{th})}}{(1 - A_0)^{(1-R) \cdot C_{th}}} \tag{2}$$

$$f = \begin{cases} \max\left(R, A_0 + A_1 R + A_2 R^2 + A_3 R^3\right) & for \;\; R \geq 0 \\ A_0 + A_1 R & for \;\; -2 \leq R < 0 \end{cases} \tag{3}$$

where A_0, A_1, A_2, A_3 coefficients are equal:

$$A_0 = (0.825 - 0.34 \cdot \alpha + 0.05 \cdot \alpha^2) \cdot \left[\cos\left(\frac{\pi}{2} \cdot \frac{S_{\max}}{\sigma_0}\right)\right]^{\frac{1}{\alpha}}, \tag{4}$$

$$A_1 = (0.415 - 0.071 \cdot \alpha) \cdot \frac{S_{\max}}{\sigma_0}, \tag{5}$$

$$A_2 = 1 - A_0 - A_1 - A_3, \tag{6}$$

$$A_3 = 2 \cdot A_0 + A_1 - 1. \tag{7}$$

α, S_{max}/σ_0 – Newman's empirical coefficients.

Determination of the above coefficients for equation that correctly approximates test data is difficult and causes some singularities described below, when the Least Squares Method (LSM) is used.

The analysis of formula (1), called the equation, shows that it contains several errors that distort the information about the processes of crack formation so that its further use is unacceptable.

A branch of science using stress intensity factors is called ***linear fracture mechanics***. Such a name is contradictory, because with linear deformation, i.e., the fulfillment of Hooke's law, cracks do not form. The formation of cracks is spasmodic, i.e., non-linear, in nature.

Linear fracture mechanics is based on the hypothesis that cracks formation and fracture are caused by the emission of elastic energy that accumulates in stress concentrators. An experiment refutes this hypothesis.

The ninth term of the NASGRO da / dN equation called the crack growth rate, is called the derivative in mathematics and is calculated using the equation

da / dN = lim Δa / ΔN

$$\Delta N \rightarrow 0, \text{ but } \Delta N \rightarrow 1.$$

The dimension of the left side of the equation is meter, the dimension of the right side is [Pa • m ^ (1/2)] ^ n. Therefore, the dimension of the left side of the equations is different. Such omissions are not acceptable in physics.

The stress intensity factors are calculated but not measured, even though they contain the measured parameters; the terms of the equation in parentheses are dimensionless. Therefore, on the right side of the equation, there are no measurable parameters.

That means that the functional relationship between the crack growth rate and the intensity coefficient of the equations is not proven, and the equation is meaningless.

Task 4.

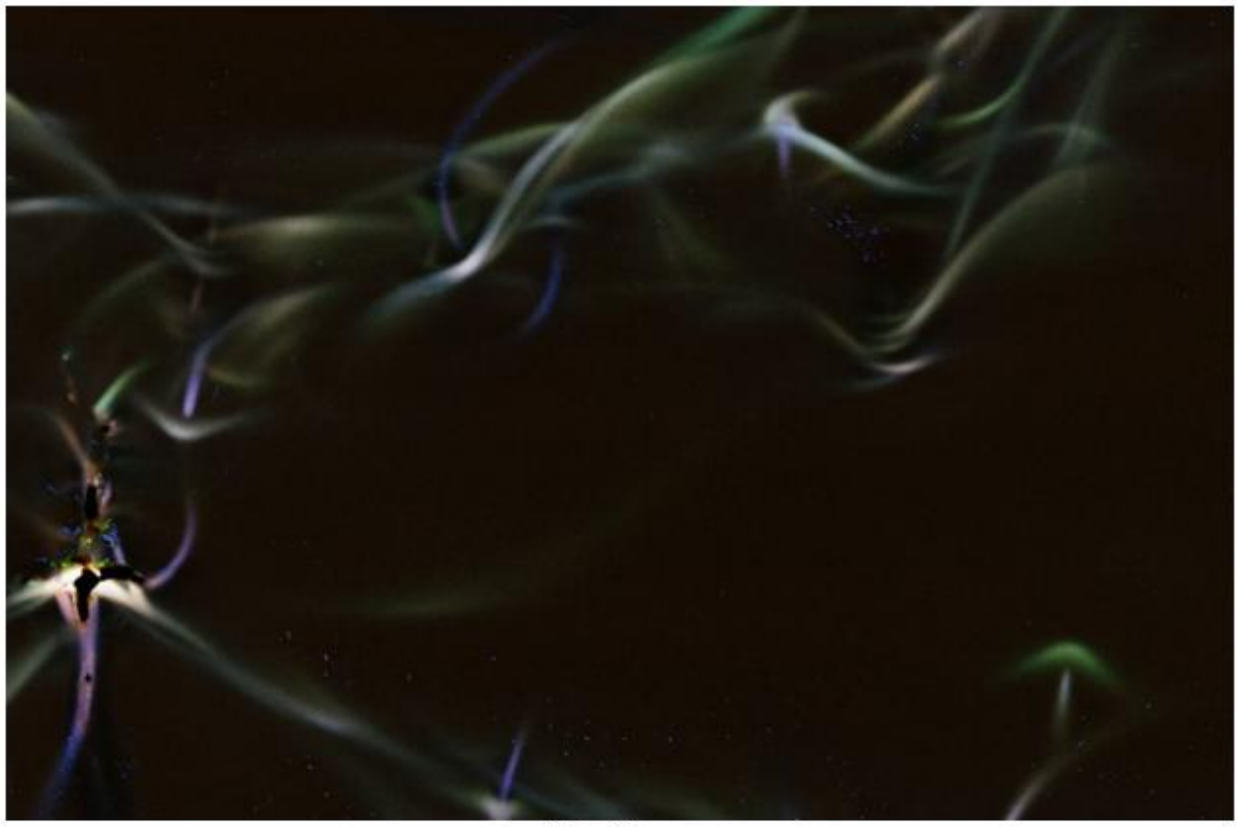

Fig. 12

Figure 12 shows a photograph of the author's heart, stents in brightly sparkling vessels and shunts.

Question:

What equipment was used to take a photograph?

1. X-ray,
2. Ultrasonic,
3. MRI machine,
4. Without apparatus.

Photo 12, one of 1534 photos, some of which are shown in my book "Non-invasive monitoring of atomic reactions and its application."

Photos were taken without any equipment on a KODAK 400 color film placed in a container that is opaque to visible and ultraviolet rays with all types of deformation or without it, all solid materials regardless of composition, shape, and size.

The simplicity of the experiment and its absolute reliability is described by a natural phenomenon called an electromagnetic pulse or the total emission of photons caused by atomic reactions.

The experiments that anyone could perform, refute all theories, methods, and models that do not take into account electromagnetic radiation.

Therefore, the correct answer is 4.

The photons' rest mass and charge are equal to zero, with maximum speed in nature fly to us from the sun, causing our hearts to beat and the brain to think.

Imagine that the publications of physicists who discovered the laws of nature, whose knowledge helped create modern industry and medicine, rest on the left side of the scale. The right side, filled with countless publications based on Irwin's false hypothesis, was published in 1957, and their weight exceeds the weight of the left scale.

This figurative comparison reflects the actual paradoxical situation of the modern strength theory. Thousands of articles are published annually based on the use of electronic, atomic force microscopes and X-ray devices, but the results of these studies are analyzed using classical mechanics. The terms photon, electron, quantum, and energy levels are not present in them.

Neglect of electromagnetic energies emitted during all dynamic processes is the leading cause of man-made disasters.

The US Standard E933 is used in other countries or is copied.

It starts with a warning: "1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use."*

But the question arises: what is the purpose of standards and the methods with the length of a crack being a main measured parameter if a minor crack could lead to disaster and death? Although there are frequent cases of catastrophes when the cracks were not discovered by existing non-destructive testing methods.

My books are intended for professionals. They are available for free on the Internet, but professionals are silent.

I believe that it is appropriate to recall the warning of Martín Luther King**, "The time comes when silence is betrayal. That time has come for us today."**