ASYMMETRY AS THE NECESSARY CONDITION FOR MASSTRANSFERE BY TRAVELLING WAVES IN SOLIDS, LIQUIDS AND GASES

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Some theoretical and experimental investigations of travelling waves of deformation in solids, liquids and gases are described. The examples of the waves analysed are well known travelling waves on water surface, waves of deformation travelling along the bodies of moving caterpillar, earth-worm, terrestrial snake, fish. The peristaltic waves in digestive system of animals and men, the wave-like motion of elastic unit of wave (harmonic) mechanisms and machines and at last the global tidal waves generated in the Earth and planet bodies by gravitation forces are analysed as well.

The examples of wave deformation on elastic elongated bodies, solids and liquids are presented in Fig.1. The global tidal waves on the Earth crust generated by the Moon gravitation and the Earth rotation are shown in Fig.2.

The theoretical investigation of mentioned waves were carried out from physics, mechanics, hydromechanics points of view. The special devices for modelling and demonstration of masstransfere ability of travelling waves in solids, liquids and gases were designed and made.

The general one-dimensional model of all above mentioned waves is proposed. This is wave of linear density made by the body mass projection on the x-axis. Function of linear density of such projection is also wave-like. The properties of this model make it possible to find out following parameters of travelling waves : averaged step of particles, averaged velosity V_x in arbitrary cross section of canal, instanteous flow rate, masstransfere caused by running waves.

The main conclusion of our analysis is : only asymmetric relatively neutral condition wave can transfere the waved body mass. It is shown that masstransfere process is relay-like (substitutional). It means that transfered mass is continiously renewed during wave moving. The parameter of wave masscontent (Δm) equal to excess ($+\Delta m$) or mass deficit ($-\Delta m$) in wave crest or trough respectively is introduced (shadowed in Fig.1, c,d,g). It is shown

that the travelling solitary waves with positive masscontent ($+\Delta m$) transfere the mass forward (Fig.1, b,c,g) and the solitary wave with negative masscontent ($-\Delta m$) transfere the mass backward (Fig.1, a,d).

The examples of symmetric (and therefore not mass-transferring) travelling waves are wind driven sea waves, waves on the water surface caused by fallen stone, acoustic waves, wind driven grassy field waves. The examples of asymmetric (and therefore mass-transferring) waves are the waves travelling along the body of moving caterpillar, earth-worm, peristaltic waves, waves in the elastic elements of wave mechanisms, tidal waves in atmosphere, hydrosphere, lithosphere and in internal part of the Earth and other planets.

Our theoretical and experimental analysis of asymmetric travelling waves led to some non-traditional approaches in different fields of science and technology :

- In biomechanics (Alexander, 1968). Contrary to the existing view (Gans, 1966; Trueman, 1974) our analysis shows that the locomotion of terrestrial snakes is based not on the "slope plane principle" but on the principle of travelling asymmetric waves of deformation (Dobrolyubov, 1986,b). It is also shown that peristaltic transport is based on the above mentioned ability of asymmetric longitudinal travelling waves to transfere the mass (Dobrolyubov, 1986,a).

- When applied to mechanism and machine theory the analysis of asymmetric waves travelling along the elongated elastic bodies (belt, rope, flexible band, chain etc.) permits to create new wave (harmonic) mechanisms and devices (Dobrolyubov, 1984).

- In geophysics :

-- the hypothesis about tidal-wave nature of propelling forces of global tectonic processes and "earthquake machine" is proposed and substantiated.Earthquake is regarded to be a result of stress accumulation caused by tidal waves in the Earth crust (Dobrolyubov, 1987). This hypothesis is entirely different from dominant one about convective processes in the Earth as a propelling mechanism of the global tectonics (Turcotte, Schubert, 1982);

-- the hypothesis about transportation of ocean water from East to West by tidal waves generated by the Moon and the Sun gravitation is proposed and substantiated. It is shown that the largescale currents in the tropic oceans (Atlantic, Pacific, Indian) are the symmetric towards equator circulations which are

a mirrow reflection of each other. This geographic argument says in favour of our hypothesis (Dobrolyubov, 1987);

--the conseption of masstransfere by asymmetric solitary waves is used for explanation of superrotation of the Earth and other planets atmosphere and solar corone. With the help of our hypothesis we gave new explanation of the Uranus atmosphere circulation picture delivered by Voyager-2 in January 1986 (Ingersoll, 1987);

--the hypothesis about wave peristaltic nature of driving mechanism of hydromagnetic dynamo which controls magnetic field of the Earth is proposed and substantiated. The peristaltic motion is in toroid ring canal in the Earth melted core (Dobrolyubov, 1988).

During the lecture the photographs of special devices demonstrating masstransfere ability of asymmetric travelling waves will be displayed.

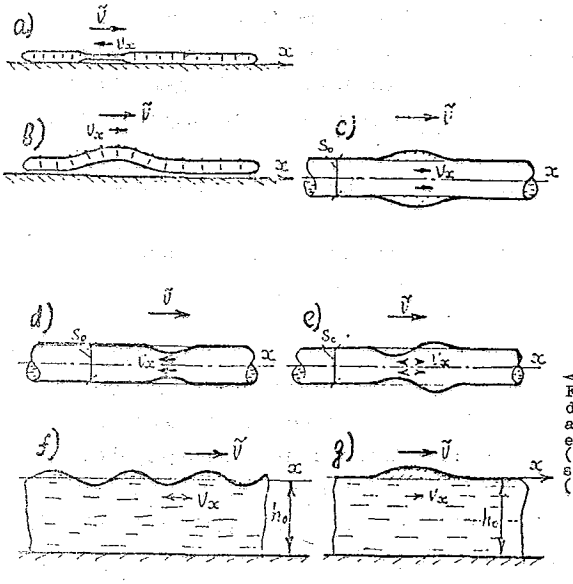

Fig.1 Different kinds of travelling waves of deformation: a,b - longitudinal and transverse asymmetric waves on the bodies of caterpillar and earth-worm; c,d,e - peristaltic waves: asymmetric (c,d),symmetric (e); f,g - waves on the water surface: f - symmetric towards undisturbed (neutral) level, g - asymmetric.

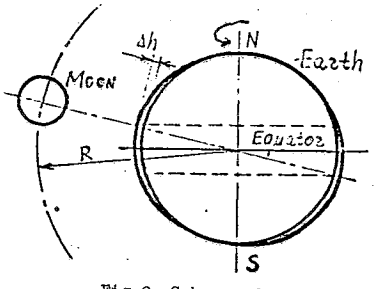

Fig.2 Scheme of generating globa tidal travelling waves in the Ear crust.

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