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50. Introscopy Used for Quality Control in Industry

"'Clear-Seeing' Devices," by P. Oshchepkov, Professor and Doctor of the Technical Sciences; Moscow, Izvestiya, 5 Feb 1965, p 3

[Abstract] In recent years in our country a new direction in science and technology has arisen and begun developing -- introscopy. In the most general meaning, introscopy is the direct vision of the inside of non-transparent bodies and media.

In essence, there is nothing which is non-transparent in nature. One must only choose the penetrating radiation correctly and one will be able to transform them into a visible image. This is the problem of introscopy.

The building of such expensive things as airplanes, missiles, superpowerful turbogenerators, atomic reactors, thermal and hydroelectric power plants, deep drilling rigs, etc. is characterized by the tremendous concentration of great material-technical means and engineering thought in one object.

Naturally, the problem of the quality of materials, parts, and units used in building such complex facilities has been sharply introduced into such circumstances. The necessity of the continuous study and control of inner processes characterizing the reliability of parts has arisen. In a number of branches of industry, especially in the ipe and sheet rolling industry, the absence of reliable means of automatic control has become an impediment to progress.

The problem of early medical diagnosis, especially timely discovery of such serious illnesses as cancer, sarcoma, cysts, and others, remains extremely difficult.

Introscopy based on the extensive use of the most diverse penetrating radiations is one of the practicable ways of solving such problems.

The physical basis of introscopy is the interaction of radiation with matter and recording the changes which they undergo in the process. Many forms of penetrating radiations can be used as an "agent" able to carry voluminous information on the inner structure, composition, and properties of non-transparent bodies and media: from gamma-quanta of high energies to radiowaves in millimeter and submillimeter ranges and also fluxes of various particles.

One of the central problems of introscopy is the transformation of these invisible radiations into visible images. Each "photo" in penetrating radiations in principle can be transformed into electrical

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"relief" and the problem of transformation in the majority of cases can be reduced to its conversion and amplification.

From another viewpoint, it is well known that the transference of fundamental principles and laws from one area of knowledge into another very often leads to fruitful results. Theoretical and experimental work shows that many basic principles of radio technology can successfully be transferred into the area of light, magnetic, and semiconducting, and even mechanical phenomena. Rich prospects for practical investigations are being opened here. Some of them have already yielded gratifying results. For instance, a number of creative collectives have demonstrated the practicable possibility of making a device, known as an "artificial eye" with a tremendous number of discretely operating elements based on miniature and superminiature amplifiers. Such transformation were first developed in our country. But it is well known that even abroad they now receive a great deal of attention. They will find extensive application.

"Innervision" has already had a significant economic effect. The use of the first gamma-television introscope in one of the machine building factories has made it possible to accomplish continuous control of welded constructions in the production process, and in addition it has set free a large quantity of X-ray film and reduced the staff of controllers. According to calculations of the planning organizations, the use of the betatron introscope being developed by the Tomsk Polytechnic Institute for quality control of hot flowing metal can save one plant more than half a million rubles a year. It has been shown experimentally that in chemistry it is possible to control not only the homogeneity of composition but also the course of processes by use of introscopy.

One of the first uses of introscopy was found in the study of the quality of semiconducting materials for studying the homogeneity of single crystals which are not transparent for visible light. But this is only the beginning. In the area of semiconducting materials and quantum radio electronics there is much to do to broaden the sphere of use of introscopy.

In scientific experimentation introscopy is necessary for studying the relief of magnetic, electromagnetic, and super-high frequency fields, for radioastronomy, for biochemistry and encephalographic research, and for the investigation of pathological changes inside a living organism. Human blood, for instance, is transparent like distilled water under observation by an introscope.

It is impossible to predict the future uses of the introscope, but its use will be significantly more expansive than that of the microscope or telescope.

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A specialized Scientific-Research Institute of Introscopy under the State Committee on Instrument Building, Means of Automation, and Control Systems of Gosplan, USSR, has been created in order to broaden work in the area of introscopy.

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[A. Ustinov article: "Penetrating the Invisible"]

[Excerpt] A new direction in science has now been born--introscopy, or intravision [vnutrivideniye].

The possibilities of the application of introscopy are infinite. They are necessary to observe and control processes in metals, concrete, fiberglass, and ploymers. They are also extremely necessary for early medical diagnosis--the discovery of tumors and the microphotography of the walls of blood vessels and the heart without surgery.

In the metallurgical industry, for example. the productivity of high-speed rolling mills equals several meters of metal per second. Naturally, under these conditions no selective control of product quality is capable of meeting the clients' requirements. In this connection the problem has arisen of the high-speed automatic control of product quality in its many aspects under flow-line conditions. In particular, a multichannel installation has been created at the Introscopy Scientific Research Institute of the Ministry of Instrument Building, Means of Automation, and Control Systems with the participation of the Pervouralsk new pipe plant. It is intended to control the quality of hot-rolled pipes during their movement along the conveyer. This enables the product quality to be guaranteed.

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