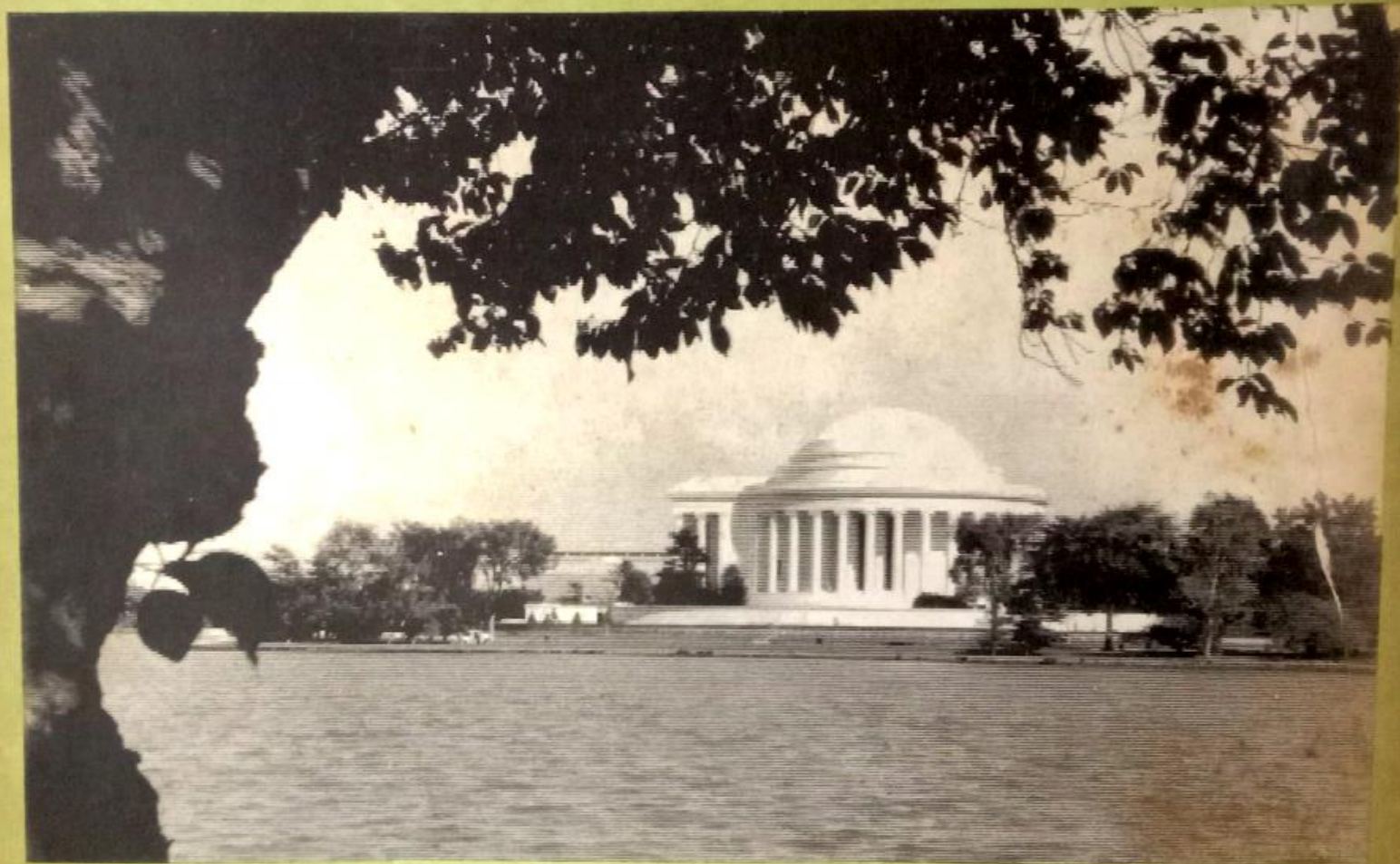


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On 10^4 regions. Magnetization measurements as a function of sample orientation indicate that the easy direction of magnetization lies in the plane of the film. X-ray data indicate that the c-axis lies near or in the plane of the films. For the hot substrate 1-5 compound the observed coercivity for an initial field of 14 kOe is approximately 11 kOe.

* Supported by MCC-BRE FRAP of GUY and U. S. ARO.
1. P. J. Cadieu et al., JAP (to be published).

DYb 11 Magnetic Susceptibility of DySb under Uniaxial Stress. D.P. OSTERMAN and S.J. WILLIAMSON, New York University; and P. MCHIN, Laboratoire Louis Néel, CNRS. The magnetic susceptibility of single crystals of DySb subjected to uniaxial stress up to 85 MPa has been measured in the temperature range from 4.2K to 20K. To avoid major perturbation of the ordered phase near the Néel temperature at $T_N = 9.5K$, a SQUID magnetometer was used with a weak magnetizing field of only 0.1 oersted. The results were compared with a mean field theory which includes crystal field effects, bilinear and quadrupolar pair interactions, and strain-quadrupole coupling. Good agreement is obtained above 10K where the susceptibility increases linearly with stress. However, below 14K and down to T_N , the susceptibility decreases with stress, suggesting a precursive effect associated with the phase transition at T_N .

DYb 12 The Magnetic Dipole Moments of Ferrimagnetic Iron and the Anisotropy Energies. C. E. MANDVILLE and G. P. AGIN, Mich. Tech. U. It has been suggested¹ that the microscopic magnetic dipole moments of iron arise largely from pairs of 3d-shell electrons which lie upon the crystallographic axes midway between the lattice sites, magnetic moments parallel and upon end. Each electron pair can be regarded as both magnetic dipole of moment $2\mu_B$ and electrostatic doublet of charge $(-2e)$. The remaining 3d-shell electrons are considered to participate in metallic and covalent bonding, leaving at each lattice point a fractional moment of $0.22 \mu_B$. The anisotropy energies per atom are $E_{[110]} = 2.22 \mu_B H(\theta) \sin^2 \theta$, where $\theta = \alpha \sqrt{2}/4$ and $E_{[111]} = 2.22 \mu_B H(\alpha) \sin^2 \alpha$, $\alpha = \alpha' \sqrt{3}$. The angles α and α' are measured away from the crystallographic directions. The torque of the applied external magnetic field works against the internal electrostatic torque generated solely by the electrostatic interaction between one rotating doublet and all the others. All concerned moments are localized. Itinerant magnetism appears to be unnecessary to explanation of the ferrimagnetism of iron.
1. C. F. Agin and C. E. Mandville, *Bull. Am. Phys. Soc.* **24**, 561 (1981).

DYb 13 Persistent Anomalous Local Field Behavior in the Extended Binary Fe_{1-x}Ni_x Ferrimagnet. L. F. LIHOLD, IRL Associates, Bethesda, MD. The one-spin and L two-spin reduced density matrices were derived for the Fe-1fcc ferrimagnet with constant coupling between n-th neighbors. These matrices $\rho_1(i)$, $\rho_2(i)$ and $\rho_L(i)$ ($i = 1, 2, \dots, L$) describe the free energy and depend on the complete set of temperature dependent local fields $\{h_i\}$ ($i = 1, 2, \dots, L$) that arise naturally in the RGVⁿ theory. The h_i and h_{ij} are readily identified as effective Zeeman and single-ion anisotropy fields respectively. For Fe, if all the local fields are identically zero, we show that although the ρ_n introduce a destabilizing effect on the system order, anomalously, they do not affect the system ordering temperature. This persists regardless of the range of coupling interaction.

DYb 14 Spin Glasses by the Oouchi-Kaneyoshi Method. Further Results. H.A. ERWIN, University of Missouri. The Oouchi method for a two-site cluster combined with a procedure for averaging due to Kaneyoshi has previously been used¹ to calculate the phase dia-

gram of an Ising spin glass. An unusual feature of the diagram so obtained was the prediction of a spin glass \rightarrow ferromagnet transition at low temperature. Further calculations of the heat capacity (C), and the susceptibility (X) as functions of temperature show a broad maximum in C and a cusp in X at T_g . However, at very low temperature they both show singularities that make the validity of the model questionable in the region.

¹M. Jursich and H. A. Brown, *J. Phys. Soc. Jpn.* **47**, 1411 (1979).

DYb 15 Density Operator Approach to the Modulation Effects in Magnetic Resonance. Yeong W. Kim, Wayne State University, Detroit. The density operator method is employed to examine the extent of the equivalence of the (sideband) structures due to the frequency and field modulations in magnetic resonance. The two structures were previously investigated by Anderson and others, who used the Bloch equation method.¹ The present results indicate rather limited equivalence, and agree with the results of the Bloch equation method only for the field modulation case. When $\gamma H_1/\omega_m$ is small, the present work predicts: (1) under the field modulation, the phase-sensitive detection of the resonance signal at ω_m would yield only those signal components which are in phase with the modulation. These in-phase signals represent the first derivatives of the rf absorption and dispersion. (2) under the frequency modulation, however, the absorption and dispersion signals would each contain an out-of-phase component additionally. This extra component does not represent the first derivative. The in-phase and out-of-phase components are proportional to $\gamma H_1/\omega_m$ and $\gamma H_1/\omega_m$ respectively.

1. W.A. Anderson, *Phys. Rev.* **102**, 151 (1954); O. Haworth and R.E. Richards, *Prog. Nucl. Mag. Res.* **1**, 1 (1964).

**SESSION DYc: BIOLOGICAL AND MEDICAL PHYSICS;
GENERAL PHYSICS
Tuesday morning, 27 April 1982
Empire Room at 10:30 A.M.**

DYc 1 Theoretical Models for Through-Bridge Electron Transfer. LESLIE J. ROOF and MARY JO ONDRACHEN, North Eastern University. Through-bridge electron transfer occurs in numerous biologically-important redox processes, as well as in a wide variety of mixed-valent compounds and bridged bimetallic clusters. The effect of the bridging species upon the rate of electron transfer in these systems is discussed. A Hubbard model is used to examine the role of purely electronic effects in determining relative rates of electron transfer and degree of localization for these systems. Such effects may be manifest in the pre-exponential part of an observable rate constant. A model for vibronic effects, based on a modified Fröhlich Hamiltonian, will then be presented. Expressions for rates of thermal electron transfer, as well as criteria for delocalization, are obtained.

DYc 2 A Simple Model for the Effect of Cholesterol on Biological Membranes. Timothy J. O'Leary, National Cancer Institute. Many effects of cholesterol on biomembranes can be described by assuming that cholesterol distributes randomly in a membrane whose melting is given by a kink model. Increasing concentrations of cholesterol decrease the membrane area and melting temperature, in agreement with experimental results. Because the cholesterol molecule cannot participate in a cooperative melting process, increasing numbers of cholesterol-lipid contacts result in a decreasing enthalpy of melting. At a critical concentration of twenty to thirty percent cholesterol, the first order melting transition becomes second order, with a corresponding increase in spontaneous fluctuations. This may have substantial effects on functional properties such as membrane permeability and protein conformation. The results of this study confirm the conclusions of other workers about the nature of cholesterol's membrane

effects, without the assumptions required by the Landau theories upon which these studies were based.

DYc 3 Effect of Solution Viscosity on the Rate of Conformational Change in the Hemoglobin Molecule. *
C.A. SAWICKI and M.A. KHALEQUE, North Dakota State University -- Rates for the R-T conformational change of hemoglobin in mixed glycerol/borate buffer solutions at 20°C have been inferred from the kinetics of CO rebinding observed at 437 nm following laser photolysis of Hb(CO)₄. In the range from 1 to 10cP a large decrease in the rate of the conformational change is observed with increasing viscosity. The dependence of conformational change rate on viscosity is not in agreement with Kramer's theory as developed by Gavish¹ which predicts an inverse first power dependence of conformational change rate on viscosity.

*Supported by Northwest Area Foundation Grant of Research Corporation (#9287)
¹Gavish, B., Biophys. Struct. Mech. 4, 37 (1978)

DYc 4 The Use of Holographic Techniques to Obtain Moiré Topographic Fringes of the Human Body. MOHSEN M. EL-SAYYAD, Cairo U., Egypt, and S. ARIF KAMAL, Indiana U., Bloomington.--Moiré topography has proved very useful for the detection and documentation of scoliosis^{1,2}. The moiré technique consists of photographing the body part to be studied through a specially constructed screen. Dark fringes are produced on the body by the screen. Since we are studying a three dimensional object (human body), holographic image of the human body through the screen would be a better way of recording. A helium-neon laser of 1.0 milliwatt maximum output with a beam splitter can be used to obtain holographic moiré fringes. This is a class II laser which complies with the safety requirements pursuant to 21 CFR, Chapter 1, Subchapter J. Ordinary moiré photographs show a lack of sharpness of fringes away from the central line. It is hoped that holographic moiré topography would be free from this problem.

¹Mohsen M. El-Sayyad and S. A. Kamal, Cobb's Angle Measurement by Moiré Topographs, Proc. 34th Annual Conf. Eng. Med. Biol., 1981.

²S. A. Kamal, Moiré Topography for the Measurement of Angle of Spinal Curvature in Three Dimensions, March Meeting of APS, 1982, Dallas, Texas.

DYc 5 Effect of 5 MeV Proton Beam on the Process of Keratinization with Special Reference to Cervix Cancer. M.M. BAJAJ, M.P.S. KHURANA, B.K. GUPTA* and D.K. AVASTHI, Phys. D., Panjab U., Chandigarh, India.-- A 5 MeV proton beam obtained from the Chandigarh Variable Energy Cyclotron was used to bombard the hard keratin obtained from healthy and diseased persons. Bombardment was made on both the sides of the pellets prepared from the hard keratin. Infrared spectra were recorded before and after irradiation with protons. Significant structural differences were observed in the recorded IR absorption bands. Studies made in the case of cervix cancer demonstrate that the proton bombardment makes the process of keratinization to go towards normalcy. It is shown that the proton beam can be used as therapeutic technique for the management of some of these serious pathological disorders. This conclusion is based on the study of the variation of the force constants pertaining to C-H stretching, C-H bending, C-H in-plane bending, C-N & O-H bonds.
*Present add.: Paediatric Surg. D., PGIMER, CHD.

DYc 6 The Biophysical Characteristics of Ensembles Afflicted With Breast Carcinoma. M.M. BAJAJ* and M.F.S. KHURANA, Physics Department, Panjab University, Chandigarh 160014, India. -- Transport processes in human fluids are studied

using the McLennan ensemble theory. Harmones, responsible for non-equilibrium in the breast are examined. The resulting ensemble has the form of product of two factors, one characteristic of equilibrium and the other containing description of irreversible cancerous process. It is found that in the cancerous state of breast, ensembles depend linearly on the local thermodynamical parameters. Transport of harmones, for states of non-equilibrium is discussed. This method is based on the introduction of some non-conservative forces which arise from the interaction between mammary glands and surroundings which transform the system into the cancerous state having non-equilibrium ensembles.

* On leave from the Department of Physics and Astrophysics, Delhi University, Delhi, India.

DYc 7 Molecular Dynamical Approach For The Transport Properties Of Carcinogenic Particles With Special Reference To Breast Carcinoma. M.P.S. KHURANA and M.M. BAJAJ*, Physics Department, Panjab University, Chandigarh 160014, India -- A new dynamical approach for the transport of the carcinogenic particles in the human fluids (such as lymph, interstitial fluids, extracellular fluids, tissue fluids, intercellular fluids, cerebral spinal fluid) is presented. The thrust of the present work is to investigate the influence of these particles on the dynamics of the body fluids with special reference to malignant growth in human breast. It is found that the dynamics of carcinogens is associated with the diffusion process occurring in cellular assemblies. The transport coefficient of carcinogens is examined using the Michels - Trappeniers type of molecular interactions.

*On leave from the Department of Physics and Astrophysics, Delhi University, New Delhi, India.

DYc 8 Quantum Statistics of Reaction Diffusion Systems in Carcinogenesis with Special Reference to Breast Cancer. M.P.S. KHURANA and M.M. BAJAJ, Physics Department, Panjab University, Chandigarh-160014, India. -- A quantum-statistical theory of reactive carcinogenic metabolites with tissues of mammary glands is presented. For the configuration probabilities of carcinogens, a system of reaction-diffusion equation is obtained. The mechanism of reaction-diffusion process responsible for the maintenance of biological order is studied and it is shown that the DNA-carcinogen reaction is a critical process. The time evolution of the configuration probability of the carcinogens $Q(a|R,t)$ is derived for this process, where a is the small biological channel and R is the position of the carcinogen in this channel at any time t .

¹C.I. Ivanov, Physica 101A, 289 (1980).

²A.M. Zhabotinski, Oscill. proc. in biol. and chem. syst. (1967).

DYc 9 Improvement in Instruments for Anthropometric Measurements. S. ARIF KAMAL, Indiana U., Bloomington-- An error of 0.2 to 0.5 cm is introduced in gridth, breadth and height measurements because different people exert different pressures. For gridth measurements pressure can be checked by adding sensitive spring balance to the measuring tape. Reading should be taken when the spring balance just starts to change from zero. For height and breadth measurements a helium-neon laser beam of 1.0 milliwatt maximum output can be used. This is a class II laser which complies with the safety

THE USE OF HOLOGRAPHIC TECHNIQUES TO OBTAIN
MOIRÉ TOPOGRAPHIC FRINGES OF THE HUMAN BODY

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Egypt.

and

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INTRODUCTION

The establishment of a workable system for early detection and treatment of back deformity is now being recognized as one of the major health problems for our society. Recently mass screening of back deformity has been widely conducted, based on visual inspections mainly consisting of the detection of a hump by a forward bending test and inspection of the shoulders, scapula, and lumber region for the left-right asymmetry. However, some of the criteria for identifying the normal and abnormal are not very distinct and the possibility of errors in judgement by individual examiners can be very great. This can result in confusingly different rates of back deformity detection in different places. Thus the problem now faced is the development of a more accurate and objective screening method.

An evaluation method to be used in both physiotherapeutic and

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pattern is originally photographed and how an image is reconstructed using laser light. In the top drawing it will be seen that the laser beam is caused to divide, so that portion of the beam illuminates the object to be photographed, and a portion is reflected from a mirror to the photographic plate. If the beam from the mirror is not present, the light reflected from the object will, more or less, uniformly expose the photographic plate and no interference pattern will be recorded. However, with the reference beam from the mirror present; at each point on the plate an interference pattern will exist.

This interference pattern contains all the information about the object that is, each point on the object reflects light over all portions of the plate, and the intersection of these reflected rays with the reference rays produces a unique interference pattern at that point. The contrast of the fringes is related to the amplitude of the reflected light rays from the object with respect to the reference beam rays. The spacing of the fringes is related to the phase, or the angle between the object rays and the reference rays.

METHODS

Thirteen children participated in this study. A 4 x 5 inch format polaroid pack for instant image production was used. Type 55 polaroid film was selected to allow both an instant positive image and a permanent negative for further study. For illumination two 1000 watt outdoor spot lights collimated through 5 cm were used. Two laser beams of type 155 were fixed at an angle of 45° . All components were held in a fixed position by a rigid frame which also incorporated a darkening

curtain.

Subject positioning was achieved by having the subject stand looking straight ahead, arms at the side in a relaxed position. This was done as close as possible to the screen without actually touching it. No attempt was made to position the upper trunk except that the subject was asked to relax. The areas of asymmetry were identified by visual inspection. The level of maximum asymmetry for each of these asymmetric areas was judged and the fringe difference between two equidistant points on both sides of the midline determined.

RESULTS AND DISCUSSION

The mean initial moiré fringe asymmetry was 1.7 fringe in the most deviant portion of the back. Significant change in the moiré photograph was defined as an increase in asymmetry of one or more fringe interval. Emergence of an asymmetry of one or more fringe intervals in an area previously symmetric was regarded as significant and a change in side of asymmetry also regarded as positive.

Using these criteria 13 subjects demonstrated both significant in their moiré photograph and hologram. 8 subjects showed significant changes in their photograph but insignificant (less than 5 degrees) in the hologram. None of them showed significant changes in the hologram with no significant change in moiré. If the moiré photograph is regarded as a true indicator of change in the two dimensional angle of spinal curvature, there were a total of 11 positive subjects (including 2 false positives) on the hologram. If the holography technique is to be used successfully in follow up of back deformities, the false negative rate

must be acceptably low. These results are indicative of this possibility.

No positioning device was used in this study. In the authors' opinion any constraining device tended to impose an abnormal posture on the subject. Positioning devices which alter the uninhibited relationship between trunk and pelvis were not used because they might mask significant changes. The relatively high false positive rate may be due to lack of reproducible positioning and more experience will be required to see if either better positioning by the examiner or a positioning device which constrains only the pelvis will diminish the false positive rate.

CONCLUSION

Preliminary experience with moiré shadow photography using holography techniques are presented. This data suggests that holography used in the follow-up may be sufficiently accurate to partially supplement X rays in the physiotherapeutic follow-up of back deformities. More experience with longer follow-up is needed.

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4. S. Inove, H. Tsuji and Y. Ohtsuka, Moiré topography, Seikeigeha

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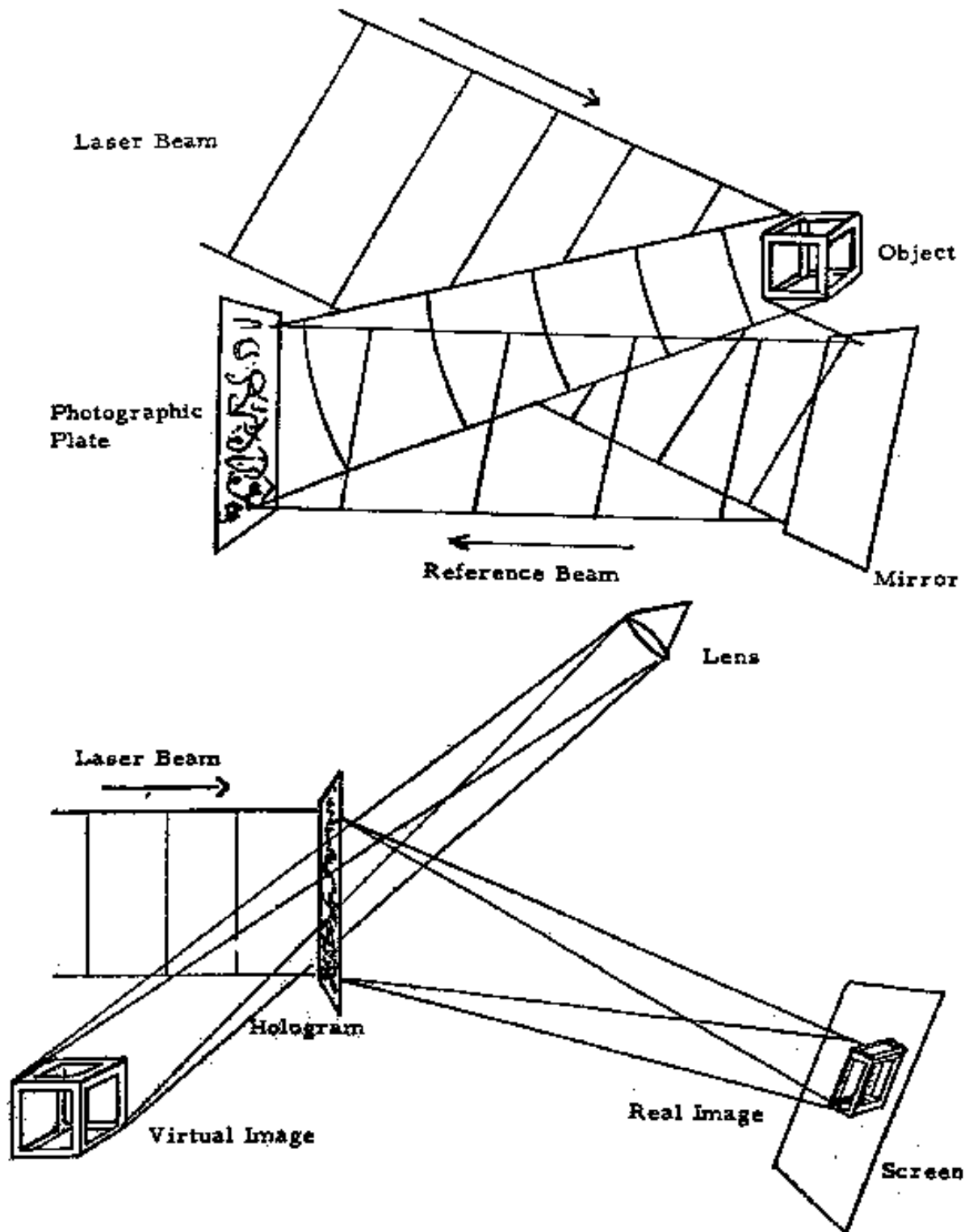


Fig. 1. Principle of hologram



Fig. 2. Laser beam type 155 used in this study

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