

50 kc/s and an image-tube pulsed and delayed to operate in the "optical radar" manner, producing spatial isolation of desired regions, selected by varying the flash to camera delays.

The repetitive source makes it possible to use the system as a direct-viewing device. Another paper from the Yoffe Institute presented by Dunaev, et al., "Optical Quantum Generator Applications for High-Speed Photography and Holography in Ballistic Investigations" (83) shows that Q-switched lasers are now generally used for schlieren studies. Illustrations showed the use of a hologram to perform additional experiments in retrospect (i. e., with optical systems not used in the original experiment).

Papers 39, 40 and 41 show that there is keen interest in image-dissection systems in the USSR especially at NIKFI and the Leningrad Institute of Kine-Engineering. Akimkina, Ivanov and Komar (39) described new lenticular plates of high relative aperture having pitch spacings of 60 μm , apertures of $f/2$ and spatial resolutions up to 400 lines/mm. From Leningrad, Grebennikov (40) and Provornov and colleagues (41) discussed improvements to raster cameras, in particular, Models RKS-2, RKS-11 and RKS-21, with considerable technical detail and thoroughness.

Papers presented at the Applications Session included "Certain Possibilities and Outlooks Related to Optical Methods Applied in Gas Dynamics" (105) by Bolotzerkovsky, of the Lebedev Institute, in which he pointed out that some theoretical approach is necessary to convert photographic records into quantitative results; he carried out such interpretations for projectiles of various shapes such as conical, spherical and flat-nosed cylinders.

"Flame Propagation in Electric Fields" by Salamandra (106) describes studies using the Toepler method. Schlieren were visible at 3,000 frames/s. A number of still examples were shown and a color film.

A paper on cathodo-luminescence (58) from the Power-Scientific-Research Institute was not presented at the Congress. The final paper presented by the USSR delegation (113) described a cinematographic study of colliery mechanisms at speeds between 1,000 and 4,000 frames/s. The paper, presented by M. N. Negodaev, Research and Designing Institute of Hydraulic Mining-Wniigidrougoel, was illustrated by film, showing that high-speed techniques everywhere are applied in an endless variety of tasks.

A special (one-paper) session on Terminology deserves particular mention. Prof. Dubovik spoke on behalf of Prof. Sakharov of NIKFI, who has prepared for consideration, discussion and amendment a *Dictionary of Terminology for High-Speed Photography in English, French, German and Russian* (97). It is arranged in an order based on the English terms or phrases and contains 850 such entries, each entry in all four languages with some additional cross-references. This is an immense and valuable work. It is inevitable that there will be differences of opinion on details and disagreement on meanings both within and between languages (probably more often than not, about choice of terms in the disputants own tongue) but this great contribution by Sakharov will be appreciated.

The USSR always produces valuable contributions at these Congresses and 1968 will go down as a new peak in both quality and quantity.

THE TECHNICAL PAPERS PROGRAM

There follows the complete listing of the papers in sequence as published in the *Proceedings of the 8th International Congress on High-Speed Photography*:

Invited Lecture: Prof. J. D. McGee (United Kingdom), Photoelectronic Image Devices — A Review

SHUTTERS

- 1 A. V. Krause, W. P. Raffan (United Kingdom), Electron Tubes for Fast Shuttering
- 2 R. W. Smith (United Kingdom), Recent Developments of the High-Speed Image-Intensifier Framing Camera
- 3 M. B. Prudence, R. A. Colmer (United Kingdom), New Developments in the Telford Image Converter Camera
- 4 A. E. Huston, S. Majumdar (United Kingdom), The Imacon — A New Image Converter Camera
- 5 K. A. F. Haynes (United Kingdom), Functional Influences on the Design of a Modern Image Converter Camera
- 6 T. H. Bulpitt (USA), Image Converter Camera System for Single Photoelectron Recording
- 7 N. G. Basov, Yu. A. Drozhdin, V. V. Nikitin, A. S. Semenov, B. M. Stepanov, V. A. Yakovlev (USSR), Investigation of Ultrashort Light Pulses Employing Time-Base Image Converter Tube
- 8 V. V. Korobkin, M. Ya. Schelev (USSR), Image-Converter Camera for Using Over Wide Time Intervals
- 9 L. V. Gavganen, L. M. Diamant, A. M. Iskoldsky, Y. E. Nesterikhin, V. M. Fedorov (USSR), Nanosecond Image Converter Framing Camera Types
- 10 V. V. Vorobyev, A. M. Iskoldski, E. P. Krugliakov, Y. E. Nesterikhin, M. Ya. Schelev (USSR), Multiframe Image Converter Registration of the Process of Ruby Laser Giant Pulse Formation
- 11 L. Guyot, D. Kaplan, M. Domalain, P. Laharrague, M. Durant (France), Tubes intensificateurs d'images et cameras électroniques fentes et à images integrales multiples à haute sensibilité—applications
- 12 D. R. Charles, G. Wendi, F. le Carvenec (France), Meshless Shutter Tube With Nine Images Double Deflection Capability
- 13 G. Eschard, R. Polaert (France), Tube obturateur pour photographie ultra-rapide

- 14 H. Bacchi, J. Marilleau (France), Dispositifs de prise de vues ultra-rapides à temps de pose compris entre 5 et 500 ns
- 15 E. Laviro, H. Bacchi (France), Camera à image intégrale de $1 \mu\text{s}$ de durée d'ouverture
- 16 M. Blanchet (France), Dispositif pour la détermination de la constante de Kerr des liquides. Propriétés de nouveaux liquides électro-optiques. Installation de remplissage de cellules de Kerr
- 17 G. Pfund (Germany), Ein Beitrag zur Entwicklung magneto-optischer Verschlüsse mit Öffnungszeiten um 10^{-7} S
- 18 F. Fringel, D. Ebeling, J. F. Suarez (Germany), Fast Electrically Actuated Optical Shutters
- 19 W. H. Allan (USA), High-Speed Drum Shutter for Ribbon-Frame Camera
- 20 W. H. Allan (USA), Foil-Shutter, Multiple-Lens Camera
- 21 J. M. Webster, R. Thomas (United Kingdom), Electro-Mechanical Uncapping Shutter
- 22 K. Chan (USA), A Unique Capping Shutter
- 23 K. Chan (USA), A High-Speed 70mm Drum Camera

Invited Lecture: Dr. Walter Stegmund (USA), Fiber Optics

STREAK CAMERAS

- 24 J. Leygonie, J. Cl. Bergon (France), Problèmes actuels d'utilisation des caméras à fente à miroir tournant dans l'étude des compressions extrêmes par ondes de choc
- 25 F. Chabannes (France), Mesure de la résolution temporelle des caméras à fente à l'aide de diodes lasers pulsées
- 26 K. C. Seddon (Australia), The Barr and Stroud CP6 Rotating Mirror Streak Camera Determination of Writing Speed

FRAMING CAMERAS

- 27 H. Lukanow (France), Eine Bildreihenkamera als ballistischer Phototheodolit
- 28 M. Koreeda, T. Yamamoto (Japan), Development of Rotating-Prism High-Speed Camera Incorporated With Registration Sprocket and Rotating Disc Shutter
- 29 A. S. Dubovik (USSR), General Theory of Mirror Image Scanning in Matrix Form
- 30 A. S. Dubovik, A. B. Granigg (USSR), Continuously Operating Mirror Scanning System in High-Speed Photographic Cameras
- 31 A. S. Dubovik, P. V. Keulishvily, G. I. Belinskaya, G. P. Iyushin

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- Yu. A. Guskov (USSR), High-Speed Photographic (PHC-1) Camera With High Aperture Ratio
- 32 A. S. Dubovik, G. I. Belinskaya, N. M. Sitsinskaya, V. V. Garnov (USSR), High-Speed SFR Camera for Use in the Visual and Ultraviolet Spectral Ranges, for Dissection, Stereoscopic and Spectral Photography
- 33 W. Ulmer (Germany), A Simple Rotating-Mirror Turbine With Air Bearings
- 34 P. B. N. Nuttall-Smith (United Kingdom), A Camera With Continuous Access for $\frac{1}{2}$ Million Frames per Second
- 35 E. D. Hartfield (USA), A New Ultra-High Speed Camera
- 36 W. J. Tonks (Sweden), An Electronic Method of Time Correlating the Film Frames of a High-Speed Beckman & Whitley Framing Camera With Subject Activity
- 37 A. Stenzel (France), Zwei Funkenzeitlupen für extreme Anforderungen
- 38 W. Thorwart, J. F. Suarez (Germany), Chronolite — Ein variables Funkenstrecken-system mit Gasdruckkammer

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- 39 L. V. Akimkina, S. P. Ivanov, V. G. Komar (USSR), New Lenticular Plates With High Relative Aperture
- 40 O. F. Grebennidov (USSR), Lichtstärke der ultrarapiden Rasterfilm-Kameras
- 41 S. M. Provornov, O. F. Grebennikov, V. P. Gushev, S. M. Perzev (USSR), Lichtstärke Rasterkamera für Kurzaufnahmen
- 42 B. R. Koetzold (Germany), Linsenraster-Hochgeschwindigkeitskamera mit einem mechanischen Verschluss kürzester Eigenzeit für selbstleuchtende, zeitlich unbestimmte Ereignisse

TIME-RESOLVED SPECTROSCOPY

- 43 R. Allison (United Kingdom), Operation and Application of a Framing Drum Spectrograph
- 44 W. A. Waller (United Kingdom), A Time-Resolving Grazing Incidence Spectrograph
- 45 P. Kafalas (USA), An Image Intensifier System for High-Speed Spectrography
- 46 S. G. Grenishin, A. S. Dubovik, P. V. Keulishvili, G. P. Ilyushin, S. N. Sidorov (USSR), High-Speed SP-III Spectrophotograph
- 47 S. G. Grenishin, R. A. Ejesin, A. E. Kolesnikov (USSR), CII-142 Time-Resolved Spectrograph
- 48 A. Bardócz (Germany), Mechanical Device for High-Speed Spectrography
- 49 M. Klenert, E.-G. Niemann (Germany), Anwendung der Schmierkameratechnik bei der photographischen Aufnahme zeitlich aufgelöster Absorptions-Spektren kurzlebiger Reaktionsprodukte

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- 50 F. D. Harrington (USA), A Time-Resolved Spectroscopic Investigation of a Flashlamp
- 51 P. Krawarik (Germany), Methods to Optimize the Efficiency of Pulsed Discharge Lamps
- 52 J. C. Moden (United Kingdom), An Analysis of the Performance of Two Xenon Flashtubes
- 53 C. G. Sluijter (the Netherlands), An Analog Circuit Simulating and Explaining the Triggering Process of an Electronic Flashtube
- 54 H. Fischer, W. Schwanzer (Germany), Radiance-Saturation and Afterglow Emission of High Pressure 20-Nanosecond Sparchannels in Argon and Helium
- 55 M. P. Vanyukov, E. V. Daniel (USSR), Investigation of Pulse Discharge in Large-Diameter Tubes
- 56 J. E. G. Wheaton (United Kingdom), The Garton Type Flash Tube, a Source of U.V. and Visible Continuum
- 57 F. Fringel, H. G. Patzke (Germany), Long Distance Infrared Flash Photography
- 58 J. G. Anikiev, V. G. Lyakishev (USSR), On the Pulse Cathodoluminescent Light Sources Based on the Excitation of Sulphides
- 59 M. Held (Germany), Selektives Stroboskop

X-RAY FLASH SYSTEMS

- 60 J. P. Barbour, M. P. Hafner, J. L. Brewster, F. J. Grundhauser, (USA), Cineradiography Using Field Emission Technology
- 61 J. L. Brewster, J. P. Barbour, F. J. Grundhauser, W. P. Dyke

(USA), 3-Nanosecond Exposures With X-Rays, Electrons and Light

- 62 D. Ebeling (Germany), Improved X-Ray Flash-Techniques Broadens Field of Application
- 63 N. Gyldeń, L. Högberg, R. Nilsson, A. Svedberg (Sweden), A Compact and Flexible X-Ray Flash System
- 65 S. K. Händel, B. Stenerhag (Sweden), A New Method for Production of Ultrafast Reproducible X-Ray Pulses
- 66 G. Thomer, F. Jamet (France), Ein Sechsfach-Röntgenblitzrohr für weiche Strahlung
- 67 F. Jamet, G. Thomer (France), Production d'impulsions de rayons X très courtes avec des rubes à décharge dans le vide du type diode
- 68 W. Schaaffs (Germany), Röntgenblitzuntersuchungen der Verdichtungsprozesse in der unmittelbaren Umgebung starker elektrischer Funken in Flüssigkeiten
- 69 P. Krehl (Germany), Röntgenblitzaufnahmen von Kopfwellen, die sich beim elektrischen Durchschlag an den Grenzen flüssiger und fester Stoffe ausbilden

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- 70 N. G. Basov, O. N. Krokhin, G. V. Sklizhov (USSR), Laser Beam Usage for High-Speed Photography
- 72 R. E. Rowlands, C. E. Taylor, I. M. Daniel (USA), Ultrahigh-Speed Framing Photography Employing a Multiply-Pulsed Ruby Laser and a "Smear-Type" Camera: Application to Dynamic Photoelasticity
- 73 A. Alfs (Germany), Erzeugung einer kleinen Serie von partiellen Rubinlaser-Riesenspulsen
- 74 K. Vollrath, M. Hugenschmidt (Germany), Photographische Untersuchung von Höchstgeschwindigkeitsprozessen im mehrfach reflektierten Laserlicht
- Invited Lecture: Prof. W. Martienssen (Germany), Introduction to Holography and its Applications

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- 75 J. W. C. Gates, R. G. N. Hall, I. N. Ross (United Kingdom), Repetitive Q-Switched Laser Light Sources for Interferometry and Holography
- 76 J. W. C. Gates, R. G. N. Hall, I. N. Ross (United Kingdom), Holographic Recording of Rapid Transient Events and the Problems of Evaluation of the Reconstructions
- 77 Ju. I. Ostrowski, A. N. Zaidel (USSR), Holographie und Kinoholographie schnell ablaufender Prozesse
- 78 C. D. Reid (United Kingdom), Cinematic Holography
- 79 J. D. Redman, M. A. Lowe (United Kingdom), The Use of Holography to Measure the Position and Velocity of Rapidly Moving Objects
- 80 M. G. Courrier, M. Leblanc (France), Utilisation des lasers en impulsions très courtes pour la mesure instantanée des déformations par methode holographiques
- 82 P. Smigielski, H. Royer (France), Application de l'holographie à l'aérodynamique hypersonique en tunnel de tir
- 83 Yu. A. Dunaev, W. M. Ovchinnikov, A. N. Berjiozkin, Yu. E. Kmatch, E. N. Koslovsky, A. I. Razumous Kaya (USSR), Optical Quantum Generator Applications for High-Speed Photography and Holography in Ballistic Investigations
- 84 F. Eisfeld (Germany), Untersuchungen an fließenden Flüssigkeitsfilmen mit Hilfe der Interferenzholographie

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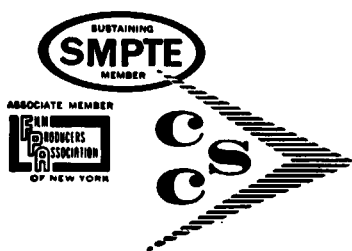
- 85 R. O. Buzzard (USA), Description of Three-Dimensional Schlieren System
- 86 W. S. Suchorukich (USSR), Beugungstheorie der Schlierenmethoden
- 87 S. Knöös (USA), A Quantitative Schlieren Technique for Measuring One-Dimensional Density Gradients in Transparent Media
- 88 R. E. Stattery, W. G. Clay, A. P. Ferdinand (USA), High-Speed Photographic Techniques in a Ballistic Range
- 89 J. Kašpar (Czechoslovakia), Colour in High-Speed Photography by Modified Schlieren Apparatus
- 90 H. Royer, P. Smigielski (France), Méthodes strioscopiques appliquées à l'étude des sillages hypersoniques à basse pression
- 91 H. Reichenbach (Germany), Funkenkinematographische Untersuchung der Stosswellendämpfung durch Mehrfachreflexionen an Blenden

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- 92 *E. Häusler, W. Stumm* (Germany), Interferometrische Untersuchung von Strossvorgängen in ebenen Stahl- und Glasmolelln mit einem Q-Switched Rubin-Laser als Kurzzeitlichtquelle
- 93 *A. M. Iskoldsky, E. P. Kruglakov, V. K. Malinovsky, Y. E. Nesterikhin, N. M. Fedorov* (USSR), Superfast Optical Methods for High-Speed Plasma Processes
- 94 *G. Smeets* (France), Aufnahmen mit dem Differential interferometer und ihre Auswertung
- 95 *G. Meier, W. Hiller* (Germany), Hochfrequenzinterferometrie als Grundlage statistisch-numerischer Schwingungsanalyse bei instationären, ebenen, transsonischen Strömungen
- 96 *J. G. Blauel* (Germany), Interferenzoptische Vermessung von einfachen, quasistationären Thermospannungsfeldern zur Bestimmung von Spannungsintensitätsfaktoren
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- 98 *H. E. Edgerton* (USA), T. Uyemura (Japan), Displacement-Time Recording with a "String"
- 99 *V. V. Garnov, A. G. Fomichev* (USSR), Application of Photorecording Methods in the Observation of Large-Scale Explosions
- 100 *L. J. Poldervaart, Th. J. Verhaegh, A. F. J. Wijnands* (the Netherlands), The Use of TV in High-Speed Cinematography Synchro Strobe TV
- 102 *V. M. Arpishkin, M. P. Vanjukov, O. B. Danilov* (USSR), The Application of Lasers With Regulated Pulses for Photographing Distant Objects With Selection in Regard to the Range
- 103 *M. R. Wall* (United Kingdom), Optical Two-Dimensional Synchronous Detection
- 104 *K. A. Pfister* (Switzerland), Apparatus With Telecentric Optics for High-Speed Cinematography of the Vocal Cords

APPLICATIONS

- 105 *S. M. Belotzerkovsky* (USSR), Anwendungsmöglichkeiten und perspektiven optischer Methoden in der Gasdynamik
- 106 *G. D. Salamandra* (USSR), Flame Propagation in an Electric Field
- 109 *W. Struck* (Germany), Kurzzeitphotografische Untersuchungen an kugelförmigen Detonationen in Gasgemischen
- 111 *H. Herbrich* (Germany), Kurzzeit-Schlierenaufnahmen von Strömungsvorgängen beim Schweißen und Schneiden mit 16 mm Rotationsprismen-Kamera und Craz-Schardin-Funkenzeitlupe

- 112 *L. S. Thickett* (USA), Some Recent Applications of High-Speed Photography Within the Steel Industry
- 113 *M. N. Negodaev* (USSR), Some Examples of the Application of High-Speed Cinematography in Designing of Colliery Mechanisms
- 114 *J. H. L. Ranson, D. W. Harper, G. B. Boulton* (United Kingdom), Laser Damage in Glasses
- 115 *A. Fayet, C. Guillemet, P. Acloque* (France), Etude dynamique de la forme du front de fracture dans l'épaisseur d'une plaque de verre trempé
- 116 *H. S. Dobbs, J. E. Field, A. D. Heyes* (United Kingdom), A High-Speed Photographic Investigation of the Controlled Fracture of Conducting Solids and the Interruption of Electric Current
- 117 *Z. T. Bieniawski* (South Africa), An Application of High-Speed Photography to Determination of Fracture Velocity in Rock
- 118 *H.-J. Wittwer* (Germany), Die High-Speed Photography als Hilfsmittel zur Analyse von plastischen Dehnungswellen grosser Amplitude
- 119 *R. W. Trease* (the Netherlands), Shockwaves in Saturated Granular Matter Analysed with High-Speed Photographs of Photoelastic Images
- 120 *H. Carabin, J. Calzia* (France), Mesures de pressions de choc à l'aide de radio-graphies-éclair
- 121 *U. Bergmann, S. Schmidt* (Germany), Kurzzeitphotographie von dem Papieraufprall auf die Druckplatte beim Funkendruckverfahren
- 122 *F. Brill* (Germany), Interferenzaufnahmen bei schnellen Vorgängen in Mikroauflicht-Bereichen
- 125 *R. M. Paoli, R. B. Mesler* (USA), Explosion of Molten Lead in Water
- 126 *J. H. Brunton, M. P. W. Wilson, J. J. Camus* (United Kingdom), The High-Speed Photography of Liquid Flow in Collapsing Cavities and Impinging Liquid Drops

SYSTEMS FOR ANALYSIS PHOTOGRAPHIC MATERIALS SURVEY PAPERS

- 128 *S. W. Hobday* (United Kingdom), A Digital Output Film Analyser With Facility for Nonlinear Scale Correction
- 129 *J. Kalina* (Czechoslovakia), Motion Analyzer for High-Speed Camera Films
- 130 *W. F. Berg, H. Strübin* (Switzerland), Das photographische Material als dreidimensionales Registeriermedium
- 131 *B. S. Brown* (United Kingdom), Optical Transfer Function Considerations Applicable to Multi-stage High-Speed Cameras
- 132 *A. De Volpi* (USA), Digital Data Recording Using High-Speed Framing Cameras
- 143 *H. E. Edgerton, V. E. MacRoberts, K. R. H. Read* (USA), An Elapsed-Time Photographic System for Underwater Use
- 144 *M. Wetzel, P. Devaux, J. Pujol* (France), Récents développements des matériels de cinématographie ultra-rapide en France