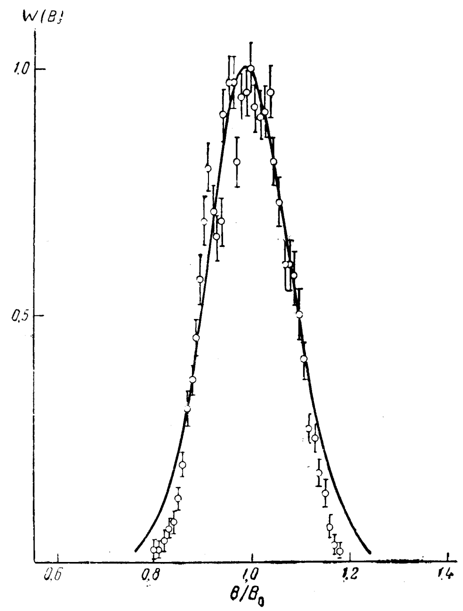

FIG. 2. Results of a measurement of the amplitude distribution for the beat signal between two laser fields. The solid line is a theoretical curve for light beams with correlated Gaussian amplitude fluctuations.

a rotating ring laser (1)[4] (containing a neon-helium mixture with partial pressures in the ratio 1 to 9, with an overall pressure of 1.6 mm Hg, operating at a wavelength of 3.39 μ, and having a side of length 0.5 m). The rotation rate was chosen so that the frequency difference between the two beams $\Delta f \cong 2$kc was several times larger than the frequency separation at which locking occurs. The mirror (2) was rigidly attached to the massive base of the laser in order to eliminate instabilities in the direction of the reflected beam, which would lead to spurious fluctuations in the amplitude of the beat signal. The photodetector was a nitrogen-cooled InSb photoconductor. The laser was operated in the single mode regime by suitable choice of the pump power and by diaphragming the beam inside the cavity.

The results of one set of measurements are shown in Fig. 2. The abscissa is the ratio of the beat signal amplitude to the mean value B_0; the amplitude distribution is plotted as ordinate. Clearly these data cannot be approximated by the distribution (2), which corresponds to the mixing of two Gaussian light waves. However, distribution (3), corresponding to the heterodyning of two light beams with Gaussian amplitude fluctuations (with $\sigma = 4.2 \times 10^{-2}$) agrees satisfactorily with the experimental data (solid line).

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[1)] It is clear that measurements of the spectral density cannot give this information.

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THE CHANGE IN THE EMISSION CHARACTERISTICS OF A RUBY LASER CAUSED BY PHTHALOCYANINE SOLUTIONS IN THE LASER CAVITY

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MANY colored organic compounds change their absorption spectra under the influence of a sufficiently intense light pulse. Terenin and co-workers demonstrated this fact using the luminescent phthalocyanines; manganese, zinc, and the free-base phthalocyanine [1,2]. Recently this effect has been used for obtaining giant pulses in the output of a ruby laser [3]. An absorption cell with a solution of one of the phthalocyanines, placed inside the laser cavity, functions as a self-opening optical shutter. It was not indicated in [3] what type of phthalocyanine was used, nor were any properties of the resulting output described.

In the present work we have studied the effect of different concentrations of solutions of various phthalocyanines on the properties of the ruby laser.

The laser used had a cavity 800 mm long, employed a ruby rod 120 mm long, and 11 mm in

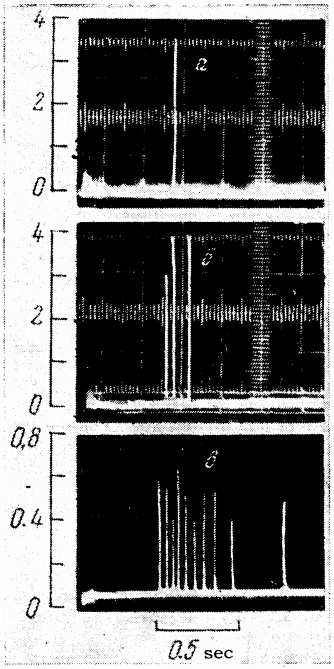

FIG. 1. Oscillographs of the output of a ruby laser for various transparencies of a solution of zinc phthalocyanine in pyridine placed in the cavity. The transmission of the solutions at 6943Å is: a – 68%, b – 76%, c – 86%. The amplitudes of the pulses are given in arbitrary units.

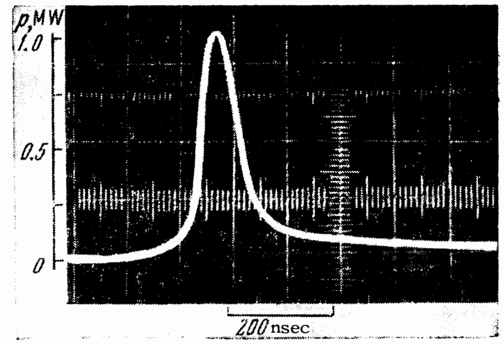

FIG. 2. An oscillogram of a single laser pulse obtained with a solution of free base phthalocyanine in quinoline.

diameter, had spherical, dielectrically coated mirrors with reflectivities of 60 and 97%, and was pumped by a IFP-2000 xenon flash lamp. For an electrical input to the lamp of 300 joules, the laser output energy was 3 joules. A cuvette with plane parallel glass windows containing a solution of phthalocyanine was placed between one end face of the ruby and one of the mirrors. The laser output was detected with a photomultiplier and an oscilloscope.

In Fig. 1 we show the emission from the laser for various optical densities of solutions of the zinc phthalocyanine in pyridine. In addition to the usual random spikes in the laser output, we observed in this case one or more very short and powerful pulses. The number of these pulses increases with increasing transparency of the phthalocyanine solution; this may be due to a decrease in the rate of clearing of the solution.

In Fig. 2 we show the shape of a single pulse. The distortion of the trailing edge of the pulse may be due to insufficient bandwidth in the detecting system. The relatively small power (about 1 megawatt) is due to the lack of optimization of the parameters of the solutions used.

Changes in the output properties of the laser were observed for the manganese, zinc, and free-base fluorescent phthalocyanines and also for the copper and vanadium phthalocyanines, which do not fluoresce.

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