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THEORY OF NONLINEAR PROCESSES

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THEORY OF NONLINEAR PROCESSES ✓

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The subject matter of this research has been quite diverse. It is naturally divided into activities of two periods, the earlier of which (1967-69) was concerned with mathematical models of biophysical phenomenon, and the later (1970-74) with mathematical modeling of non linear processes especially those concerned with quantum optics and non linear wave propagation. The results of the research over the seven years of the contract are recorded in the published papers named on the publication list. Reprints of these papers are included.

The topics investigated in the early biophysical phase were:

- 1) Statistical mechanics of macromolecules especially as related to DNA denaturation processes
- 2) Electrostatics of models of lipid films and interfaces between fluid layers
- 3) Modeling of exciton migration in photosynthetic units

A transition from the original program on biophysical processes into the new program on nonlinear process was made in our research on nonlinear models of population growth and competition. The equations which govern these processes are similar to those which occur in certain models of laser dynamics.

The topics studied in the program on nonlinear process included:

- a) Model systems in quantum optics
- b) Nonlinear wave propagation in crystal lattices
- c) Basic studies in nonlinear dynamics
- d) Wave propagation in a Navier-Stokes fluid

In our early work on nonlinear processes, emphasis was placed on the construction of solvable nonlinear models for phenomenon of interest. We were successful in finding a number of models whose mathematics would be discussed in great detail without making uncontrolled approximation and from these we enlarged our intuition about nonlinear phenomenon in general.

Our more recent work has emphasized the development of novel perturbation methods. In these methods we have been able to avoid the secular term problem and those of small denominators which have been traditional difficulties in older procedures.

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