A neurobiophysical model is proposed for the explanation of some characteristics of schizophrenic behavior. The normal reactions to exogenous stimuli are mediated through a set of centers, while some endogenous stimuli result in abnormal reactions removed from reality, such as dreamlike states, paranoias, hallucinations, etc. The two sets of centers are cross-inhibited and the usual equations for such cross-inhibited systems are applied. In normal life exogenous stimuli as a rule result preponderantly in pleasant reactions, and the corresponding pathways are therefore reinforced. This results in an inhibition of the abnormal reactions. If the life history of an individual is such that a sufficiently large number of ordinarily experienced stimuli leads to unpleasant reactions and, therefore, the corresponding pathways are inhibited, the endogenously stimulated centers for abnormal reactions prevail and various schizophrenic symptoms occur. The same result may be achieved with a normal life history but through organic changes in the system, which differentially affect various thresholds and excitation parameters. The model thus leads to the conclusion that what appears now to be a large array of contradictory findings in the “organic” versus the “psychological” controversy is actually not a contradiction, but is a result of the dependence of normal and abnormal behaviors on a large number of neurobiophysical parameters. Some general comparisons between the conclusions drawn from the model and some known facts are made. The model also provides a first step toward a neurobiophysical interpretation of the mechanism of psychotherapy.

A survey of the literature on schizophrenia or the schizophrenic reactions reveals a bewildering and confusing picture. Classification of schizophrenia is still unsettled. As Don D. Jackson (1962) puts it, “the symptoms are the disease.” Opinions regarding etiology of schizophrenias as well as the nature of the disorder are equally controversial. A number of experimental studies has been made of various organic disturbances that allegedly accompany schizophrenias and are closely related to them. Some interesting positive results
were obtained and hopes of finding an organic explanation of schizophrenias rose. But as the number of investigations increased it began to look as if every positive finding might be matched by a negative one. The hopes for an "organic" explanation thus seemed to be receding (Jackson, 1960). Recently a "psychosociological" point of view seems to begin to be prevalent (Fromm-Reichmann, 1961; Jackson, 1962). Schizophrenias, from this point of view, may be considered as peculiar "psychosociologically learned" reactions.

Paralleling this seeming confusion of the views on the nature of schizophrenia, we find similarly conflicting views on methods of treatment. The "organicists" raised high hopes for such treatments as the administration of thyroid (Richter, 1957; Gjessing, 1932, 1938; Danziger and Kindwall, 1948), the more drastic treatments of various shock therapy (metrazol, insulin, electric shock), or even the very drastic prefrontal lobotomy (Freeman and Watts, 1950; Greenblatt and Solomon, 1953). It can hardly be denied that each method of treatment has given positive results in some, but only some, cases. Recently the introduction of tranquilizing and related drugs gave hope for both a biochemical interpretation and biochemical treatment of schizophrenias (Delay and Deniker, 1956; Gellhorn and Loofboorow, 1963; Heath, 1963; Hess, Shore, and Brodie, 1956; Himwich, 1958; Richter, 1957; Jackson, 1960). Yet other studies (Apter, 1960; Kety, 1959; Benjamin, 1958) indicate that the "cures" thus obtained are at best temporary.

It seems that about the only thing on which everybody concerned agrees is that the different forms of schizophrenia are characterized by a withdrawal of the patient from reality. This withdrawal may manifest itself either in a catatonic stupor, in hallucinations, or in paranoid disturbances of the thinking processes, disturbances that make the patient live in a world of his own.

Whatever the nature of the schizophrenias, they are manifested by pathological behavioral reactions, and thus directly involve the central nervous system. It is, therefore, interesting and possibly useful to see whether the mathematical biology of the central nervous system (CNS) can offer suggestions for a model of schizophrenic behavior. To investigate this possibility is the purpose of the present paper.

Like all theoretical models, our model must perforce be oversimplified and abstract. Even a very oversimplified model may be quite useful in the early stages of a theoretical investigation. The concept in the kinetic theory of gases of a molecule as a rigid elastic sphere, whereas it actually consists of a complex nuclei and dozens of electrons located in different orbitals, is probably as drastic and unrealistic an oversimplification as can be imagined. Yet its usefulness in the derivation of numerous properties of real gases is a matter of record.