After a number of remarkable experimental investigations accomplished, within the last twenty years, in the laboratories of Professor Maurice Fontaine, after the numerous and most interesting works of Professor Grace E. Pickford and her collaborators, as well as the appearance of her book of high scientific significance (Pickford & Atz 1957) giving a systematized critical summary of numerous works devoted to the hypophysis of fishes, and finally, after a series of correlated histological and experimental investigations in our laboratory (1939–1959), I shall be able to make in this short lecture only a few slight additions based, mainly, on the ecological approach to the question.

The investigations realized in the plan of comparative morphology (anatomy, histology and embryology) of the hypophysis made it possible, as we know, to explain the profound differences in this organ in Teleostei and Acipenseridae. The exceptional development of the racines of neurohypophysis connected with the absence of cavity and with the appearance of a large transition zone in the adenohypophysis of Teleostei removes them from Acipenseridae and from a whole range of vertebrates. The morphological differences in the hypophysis of the Teleostei and the Acipenseridae are so profound that they make homologization of the parts of this organ extremely difficult.

In this facet of the evolution of vertebrates there take place considerable changes in the localization of the gonadotrophic function and also there is a differentiation in the way of incretion from the adenohypophysis. Profound changes also occurred in regard to the connection of the hypophysis with the hypothalamic part of the intermediate brain. It is known that the hypophysis
of Acipenseridae has retained certain traits of ancestral primitiveness, for example, the diffuse penetration of the cavity of the infundibulum (recessus infundibuli) into the neurohypophysis. However, in relation to the connection of the hypothalamus with vegetative nuclei Acipenseridae stand nearer to amphibia than to Teleostei (nucleus lateralis tuberis, so characteristic of the Teleostei absent in Acipenseridae) (Polenov & Barannikova 1958).

Such data, obtained on the basis of applying the comparative method, in line with other histological and cytological peculiarities of Acipenseridae, may be of some interest to phylogenetic speculation, and to comparative histology perhaps, but they meet the demands of endocrinology itself only to a very slight degree.

Entirely different results are obtained by the analysis of the organ on the basis of ecological principles. It is not, however, a question of investigating the influence of separate exogenous factors on the function of the endocrine organs in experimental conditions. Fully acknowledging the scientific value of the works of this group, we realize, at the same time, that this method of analysis has a limited significance, for in nature organisms, populations and species are connected not with factors of surroundings isolated one from another, but are always connected with the combined influence of numerous factors.

The line of investigations which our laboratory is trying to develop, "Ecological histophysiology" as we call it (Gerbilskii 1956), is characterized by the general theoretical problem – analysis of the modus of development of phylogenetic adaptations based on the elucidation of the processes of realization of similar adaptations in ontogenesis. In this respect the endocrine organs seem to have great significance.

We are elaborating this line of histophysiology by examples taken from a very interesting and large group of adaptations connected with the reproduction of fishes.

We regard the hypophysis as a very important component in the system of correlated organs on the basis of functional lability of which the phylogenetic adaptations of this group developed during the process of evolution.

We consider that a knowledge of the role of the cell and tissue structures during the realization of these adaptations in ontogenesis unites the interests of comparative endocrinology and evolitional histology.

The ecological histophysiology of the endocrine organs also unites the interests of endocrinology with the general problems of zoology; for example, the problem of the quantity of a species, the problem of the biological differentiation in the limit of species, as well as that of migration and the question of migration impulse.

Lastly, ecological histophysiology of the endocrine organs draws together interests of endocrinology with the practical problems of biotechnique.
Allow me to ground this thesis on examples taken from the work of our laboratory. Though, undoubtedly, there can be found in world literature other examples, their quantity increasing from year to year.

In the world of fish we find a great variety of adaptations connected with reproduction which promote the biological progress of a species, i.e., maintain the quantity in its optimal degree and enlarge its areal. The regulation of the function of the reproduction system plays a considerable role in the realization of many of these adaptations. As far back as 1930 and 1940 a series of works (by Gerbilskii, Kasanskii and other authors) have demonstrated that adaptations connected, for example, with the season of spawning (spring, summer, autumn) or with a type of spawning (total or portional spawning) occur on the basis of the functional plasticity of the hypophysis and the regulation of the gonadotrophic function of this organ. This functional plasticity finds its vivid morphological expression in the peculiarities of the secretory function of the basophil elements which produce a secretion containing gonadotrophic hormones. It was shown that in fishes with spring-time spawning this secretion was accumulated back in autumn and the first half of winter in the form of acidophil granules which sharply refract light.

In the case of fishes with total spawning this incretion is internally secreted from the hypophysis in a very short time, whereas with fishes in portional spawning the same process stretches over a long period of time and is correlated with recurrent waves of the process of meiosis and ovulation. Lastly, in fishes with autumn spawning this sort of accumulation of hormones does not occur in as much as the time of its maximal accumulation coincides with the period of spawning. At the same time a distinct solution was reached concerning the question of whether the hypophysis is a gland of accumulation or not. If the question is disputable when applied to the higher vertebrates, in fishes the positive solution of this question is indisputable. The genetic remoteness of such species as, for instance, the zander (Lucioperca lucioperca L), the white salmon (Stenodus leucichthys Güld), the bream (Abramis brama L), the pike (Esox lucius L), the crucian (Carassius carassius L), the loach (Misgurnus fossilis L) and the stickleback (Gasterosteus aculeatus L) permit us to discover ecological parallelisms expressed in similar functional changes of hypophysis in fishes of different systematic groups in connection with a resemblance of ecology and type of spawning.

As the same time, however, the genetic remoteness of the species compared, i.e., forms usually having very different norms of reactions, limits the significance of such investigations and does not permit of understanding the functional basis of the phenomena of adaptations in a comparatively short interval of evolution time. In this respect our attention is attracted by seasonal races and biologically different groups within the limits of a species in general. The phenomenon of the differentiation in the limit of species is regarded by
us as one of the more widely spread forms of adaptation permitting a species or its isolated population to make use of possibilities, afforded, more fully, for example, the feeding produce or spawning places afforded by an area or its relatively isolated part. For this reason we are greatly interested in the role of the endocrine system, and the hypophysis in particular, in the development of these adaptations.

In a work published previously Gerbilskii (1947) has demonstrated the great difference in the condition of the hypophysis in the individual groups of Caspian osetr caught during the period of anadromous migration in the Volga river. This phenomenon was studied more profoundly by I. A. Barannikova who found the difference in the function of basophile cells of the hypophysis of the Kura river osetr (Acipenser güldenstädti persicus Borodin) belonging to different biological groups (Barannikova 1950). These differences stand out more clearly in the ventral parts of the anterior lobe of the hypophysis, where, as demonstrated by Barannikova, the gonadotrophic function of this organ is localized.

The investigation of the functional conditions of the hypophysis and gonads in anadromous fishes during the period when they are going from sea to river permitted us to clear up the different types of anadromous migrators within the limits of a species and also within the limits of the spawning populations of certain species in one river. In the one case we have to deal with hibernating migration (wintering in the river before the spring spawning), and in the other case with a real spawning migration after hibernation in the sea. It is clear that the nature of the migration impulse in these extreme types of migrators is quite different (Gerbilskii 1957).

Therefore, the hypophysis plays the leading role in the development of adaptations connected with the reproduction of fish in the world. It is also beyond all question that in this respect thyrotrophic function of the hypophysis has a great significance (Fontaine 1953).

As we have stated, ecological histophysiology draws together the theoretical interests of endocrinology and the practical problems of biotechniques. This may very well be demonstrated by the example of that part of the fish economy which deals with the reproduction of the fish supply in the natural reservoirs by means of piscicultural measures. This part of the fish economy has become exceptionally significant in connection with the development ofhydrobuilding which changes the conditions of rivers, lakes and seas.

For example, sturgeon piscicultural economies are called upon to compensate the damage done to the supply of these most valuable anadromous fishes. These economies successfully carry out their task, obtaining mature sex cells of the sevriuga (Acipenser stellatus), sturgeon (Acipenser güldenstädhti) and white sturgeon (Huso huso L) caught in the down stream of the
Volga, Kura, Ural, Kuban, Don and other rivers, applying the method of hypophyseal injection for this purpose.

It is clear that in the process of introducing this method into the practice of pisciculture it was necessary to study the seasonal dynamics of the contents of the gonadotrophic hormone in the hypophysis (with a view to determining a more rational time of preparing the acetonized hypophyses). It was also necessary to carry out a number of experiments on the question of the specificity of the gonadotrophic hormone in fishes of various species, as well as on a question of paramount importance both in theory and practice, the question of the sphere of influence of the gonadotrophic hormone upon gametogenesis and ovulation. Thus, for example, in recent years a series of experiments carried out by B. N. Kasanskii made it possible to determine exactly that the normal reaction of the hypophyseal injection of the side of the ovary can be obtained in the case of Acipenseridae beginning with the completion of polarization of the ovocyte and the migration of nucleoli from the periphery to the centre of the nucleus. It was also determined that the quickest results and results which set in soonest are obtained with the usual dose in the period when preovulating nuclear changes in the ovocyte of the older generation are characterized by the phenomena of meiosis beginning with the metaphase of the first and ending with the metaphase of the second meiotic divisions (Kasanskii 1957). These facts proved to be useful in pisciculture application to different biological groups of Acipenseridae with the purpose of rationalizing the seasonal schedules of sturgeon economy.

We now obtain the material for the acclimatization of so valuable a fish as the sterlet (Acipenser rutenus L) not only by keeping the young in the rivers, but also by making use of hypophyseal injections (Persov 1957).

Like other authors (Atz & Pickford 1959), I think that this method will in the near future make it possible to obtain the posterity of the valuable fishes of the Chinese plain faunistic complex in producers' quantities in this way without keeping the larva and young of these fishes in the rivers (Gerbilskii 1959).

To this day endocrinologists prefer working with convenient living models—laboratory animals in the conditions of the experiment—doing comparatively little work in the study of the normal functions of the endocrine organs of wild animals in relation to the conditions of their life in nature. At the same time the zoologist-ecologists, and systematists the more so, manifest no inclination for problems of evoluctional endocrinology and for the methods of endocrinological investigations. We hope that the further development of ecological histophysiology of the endocrine organs will promote the advance of the role of endocrinology in the most valuable problem of general biology—the problem of phylogenetic adaptation and in the elaboration of the scientific bases of biotechniques.
REFERENCES