ture effects on organic processes, the contrasting action of acids and bases, gelation, coagulation, surface-tension and the structure of emulsions. This technique, therefore, makes possible in an introductory course of general biology the inclusion of experiments on biochemical subjects heretofore regarded as too difficult or impractical, and these subjects are the very ones most essential to any consideration of organisms as physicochemical mechanisms.

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MARKING LIVING FISHES FOR EXPERIMENTAL PURPOSES

IN experimental investigations with fishes it is frequently desirable to be able to distinguish individuals. When more than a half dozen are used at a time this becomes somewhat of a problem. Large fishes may be "tagged" by the methods in use in the Bureau of Fisheries, but these methods are inapplicable to small fishes, such as *Fundulus,* which are commonly used for experimental purposes. Clipping or punching the fins leaves an opening for infection and interferes with the normal movements of the fish. For experiments of brief duration, stains such as mercurochrome may be used, but these wash off in a very few days.

Using *Fundulus parvipinnis,* I tried marking with a fine hypodermic needle and india ink. Excellent results were obtained when the needle was inserted under a scale from behind, holding the syringe nearly parallel to the fish's body. The introduction of the needle must be carefully made; as soon as the point "takes hold," a delicate pressure is applied to the plunger and the needle withdrawn immediately. The needle should penetrate the scale pocket but must not break through the dermis. A little practice is all that is needed to rapidly mark large numbers of fishes without injuring them. When properly done the result is a round black spot from one to two millimeters in diameter which remains intensely black for several weeks and only begins to disappear after forty to sixty days. The mark seems to be absolutely permanent on specimens preserved in formalin.

In this laboratory over three hundred fishes have been thus marked and kept under various environmental conditions for periods ranging from two weeks to several months without showing the slightest harmful effect of the marking. Any part of the fish may be marked, but I have found the sides and venter most suitable, avoiding the head and the lateral line.

A number of other inks and stains were tried, but none of them proved satisfactory, some not holding their color and others causing a harmful local irritation. With a good grade of india ink, however, it was remarkable that not even a slight swelling or distortion of the scales was apparent and not a single case of infection was seen.

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SPECIAL ARTICLES

ASSOCIATION OF THE CAUSATIVE AGENT OF A CHICKEN TUMOR WITH A PROTEIN FRACTION OF THE TUMOR FILTRATE

SINCE 1911 when Rous reported on the transplantability of a chicken sarcoma a number of other fowl tumors have been transplanted and studied. The outstanding features of these sarcomata are that they can be transferred to no other species of fowls; that all, with the exception of two, differ from each other in their histology and general biological behavior on transplantation; and that the tumors in transmission from fowl to fowl retain all their finer characteristics and can be passed from fowl to fowl by filtrates and desiccates as well as by grafts of living tumor cells. While the filtrable agents obtained from the tumors have been generally referred to as viruses, their extreme specificity and the multiplicity of tumor types which are faithfully transmitted in each case by the agent seem to separate them from the virus class of disease producing agents as generally defined at the present time.

In our recent studies we have endeavored to determine more precisely the nature of the tumor-inducing agents, which possess the power to stimulate cells not only to grow but to undergo differentiation in specific ways. The present report deals with the results of the fractionation of the proteins contained in the extracts of Chicken Tumor 1 of the Rockefeller Institute series.

In the first tests differential precipitation was accomplished by dialyzing out the salts by means of the ingenious apparatus devised by Dr. J. J. Bronfenbrenner. After concentrating the Berkefeld filtrate of the tumor in Alumdun thimbles lined with soluble cotton membranes, the salt content of the concentrate was reduced by electrodialysis. In the very short time of three to seven minutes, a clear, mucoid material precipitated out, for the most part about the positive pole and in the bottom of the thimble. This precipitate injected into chickens proved active in the production of tumors; while the remaining fluid, though still containing considerable protein, proved inactive. Moreover the tumor agent may be precipitated in a highly active form by electrodialysis from

the serum of tumor bearing chickens. The result of this test may be interpreted as indicating either that the active agent carries a negative charge and is attracted to the positive pole, or, as seemed more probable, that the precipitate around the positive pole is brought about by the greater concentration of acid salts in this region. In fact the latter interpretation appears to be the correct one, for by lowering the isoelectric point of the concentrate with weak acid, the same kind of precipitate is thrown down, carrying with it the active agent contained in the fluid. Furthermore this precipitate may be dissolved and reprecipitated without loss of its activity.

The degree of purity of the protein fraction which carries the active agent has not yet been determined. Preliminary tests seem to eliminate the presence of mucoprotein, as was first considered probable for no reducing substance is found after hydrolyzing with sulphuric acid. The presence of the purine bases and phosphorus suggests that the major portion of the fraction consists of a nucleo-protein. The fraction gives also a uniform Feulgen reaction[1] of the so-called thymonucleic acid group.

Although no definite conclusion can be drawn at the moment from the results reported, yet when they are considered in the light of known properties of the chicken tumor agent, the probability of its enzyme-like nature is strengthened.

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A "FOSSIL" CAMEL RECENTLY LIVING IN UTAH

THE fragmentary skull described below was submitted to the writer for examination by Professor A. L. Mathews, of the University of Utah, at present lecturer in paleontology in the University of Chicago. It consists of a practically complete braincase and most of the palate. The bone is perfectly fresh in appearance; no replacement has occurred; a bit of dried muscle is still present on the basioccipital. Concerning the find Professor Mathews states:

> The specimen was discovered by two high-school boys of Fillmore, Utah, who, at the time, were exploring the igneous buttes some twenty miles south and west of that village. It was found about two hundred feet back in a cave, buried under about three or four feet of fine dry eolian deposit, which was easy to excavate. The cave is one of the many caverns formed in the old lava beds of the district, which, according to Gilbert,[1] are post-Bonneville in age.

All its characters, including those of the teeth and tympanic region, show it to belong to the Camelidae. Its size is about that of the existing old world camels and this, together with a number of anatomical features, rules out reference to the South American llamas. The most obvious explanation seemed to be that the skull was that of one of the imported dromedaries which were released in the southwest in the 70s.

This is not the case. Comparison has been made with both the dromedary and the bactrian camel, through the kindness of Dr. Osgood, of the Field Museum of Natural History, and a large number of differences became apparent, some of which are noted below. While it seemed absurd that this fresh skull was that of a Pleistocene form, it agreed so well with Merriam's figures of La Brea camelids[2] that comparison with the Pleistocene *Camelops* from that locality was arranged through the kindness of Dr. W. D. Matthew, of the University of California. With the skulls of both the living camels and the La Brea type before me, the identity of the Utah specimen with *Camelops* is unmistakable. Some fourteen points of comparison have been noted; a few of them are presented here:

(1) The lateral occipital openings are large in the Utah specimen. They are large in the La Brea forms; small in the old world camels. (2) The paroccipital process and mastoid are closely united externally. The same is true of the La Brea forms. The two diverge, leaving a groove between them, in the old world camels. (3) The basisphenoid-presphenoid in the Utah specimen form a prominent V-shaped ridge, as in *Camelops*. They are smoothly rounded in the living camels. (4) The glenoid is high up on the skull, about one and one half inch above the level of the basisphenoid, in the Utah specimen and the La Brea forms, while in the living camels this point is almost on the level of the basisphenoid. This causes a striking difference in the contours in the side of the skull, the origin of the zygomatic arch, etc. (5) In both the Utah specimen and the La Brea camels the post-glenoid opening is small, and an additional foramen (noted by Merriam) is present at the outer end of the glenoid. This foramen is absent in the living camels and the post-glenoid foramen is large. (6) While the edge of the orbit is not shown in the specimen, the anterior end of the masseteric rugosity and the situation of the portion of the maxilla enclosing

[1] We are indebted to Dr. E. V. Cowdry for calling our attention to this reaction.

[1] Gilbert, G. K., 1890. Lake Bonneville. Mon. U. S. Geol. Surv. 1, 329–332.

[2] Merriam, J. C., 1913. Univ. Calif. Bull. Dept. Geol. 7, pp. 305–23.