The Feet of Animals.

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The adaptation of means to an end is nowhere more beautifully illustrated than in the conformation of the feet of various animals. If this difference of conformation were limited to difference of class or order, the wonder would not be so great. It is not at all strange that the foot of the camel and that of the horse should differ, but there is something striking in the fact that the feet of members of the same genera should differ. This shows the readiness of nature to adaptation, or, in more scientific and exact language, proves the power of the circumstances of the creature's environment. Just as any competent naturalist can from the back tooth of an animal, before unknown to him, tell the story of that animal's life, habits, and nature, so the same naturalist could tell the same story by a study of any animal's foot.

Take the hare for an example. The foot of the common hare will, on examination, show mainly the ability of the creature to make great leaps and to make an equally quick recovery. The external condition of the foot indicates nothing peculiar in the habits of the animal. It is distinctly divided between the toes, and is covered moderately with hair. Now examine the foot of the Carolina hare. At the first glance it is not different from its cousin's foot; but a closer scrutiny discovers a partial web between the toes, and a lesser quantity of hair on the whole foot. These characteristics point infallibly to the fact that the hare is at home in either marshy places or in water, or in both. And so in fact the Carolina hare is, taking to the swamps and to the pools in the swamps as readily as a water bird. Look now at the foot of the Arctic hare, and there will be found a very different sort of modification. This hare must travel over the yielding or, as frequently, slippery snow, and it needs a foot which will at once offer the greatest surface and the most resistance to slipping. These requirements are met by a greater expansion of the membranes of the toes and mainly by a very heavy growth of hair on the foot between the toes. The foot of the Arctic hare is even more a snowshoe than the foot of the aquatic hare is a paddle.

This same modification is found in the feet of dogs. The Eskimo dog has the snowshoe foot, the water dog the paddle foot, while the greyhound, for example, has a foot formed on the model best adapted to speed, that is to say, it is small, light, and hard, But this modification of a foot to suit land, water, or snow is too common an occurrence to cause the surprise it otherwise would, although there happens now and then a failure to adapt which serves to emphasize the fact—as in the case of the deer, which, instead of being so modified that it can bear itself up as if on snowshoes, is obliged to let skill step in where modification fails to come. When the snow is soft it sinks helplessly in and flounders about as clumsily as any other animal less used to the feathery material; but when there is a crust on the snow, as there generally is in the northern regions, even though that crust would sink under the same weight of horse flesh, the deer knows how to glide over it in safety. How much of an art this is can be best appreciated by watching how the light-footed cat will come to grief on the glistening surface of crusted snow. In spite of its sharp claws it will slip this way and that, and finally break through, where five times the weight of reindeer or moose flesh would have skimmed along with ease, speed, and safety.

It is needless to say that the cat has never adapted itself to either snow or water. And yet the foot of the cat has been modified from its most perfect form, as found in the lion and tiger, where the formation is so beautifully fitted to leaping and alighting. In the latter particular, the adjustment of the muscles and bones to a minimum of shock is marvelous. The man who jumps down but a few feet and, despite his utmost efforts to save himself, nevertheless jars his whole frame, can best marvel at the ease with which the members of the cat family alight from great heights. Even the ponderous body of the lion or tiger makes hardly more noise than a rubber ball coming to the ground. From the lion to the cheetah, the foot is essentially the same, but it is nevertheless modified in minor particulars to suit the differing conditions of the various members of the great family.

It is among the birds, however, that the greatest variations in feet are to be found. At first sight some of the variations seem arbitrary, but a little study soon shows that in this, as in all respects where nature holds sway, everything is logical. For example, we have the water ousel, a member of the thrush family and yet a water bird. It might fairly be expected to have webbed feet, but it has not. Its young take to water even more readily than young ducks, and it delights in the most turbulent streams, as if its passion for the water could only be appeased by indulgence in it under its roughest form. It has been known to build its nest behind a waterfall, darting through the falling water with as little concern as if it were only mist; and the nest itself is placed where it is constantly being sprayed upon and where the first sound the little ones will hear is the music of its fall. And yet this bird has not the webbed foot of the true water bird. And why? Because it has no use for its feet in swimming the short distance it does. Its wings are equal to all emergencies, and hence its feet have never become modified.

The webbed foot is spoken of as characteristic of the true water bird, and so it is; but there are nevertheless many birds whose whole lives are passed on or in the water whose feet are not webbed—as the grebe, which for swiftness of motion and celerity in diving is not surpassed by any bird. It has only a partially webbed foot, each toe being provided with a fringe of membrane which answers to the purpose of a full web when in the water without being as much of an incumbrance when the bird is on land.

Then too some of the wading birds are provided with webbed feet while others are not. In most cases it will be found that the webbed foot is present only where the use for it is obvious, as where the habitat of the bird is in the swamps. Where it is found in the true wading birds, it is for the most part a relic of a previous state. Where the bird frequents water instead of ooze, there is no need of a web, and it is very seldom present.

One of the most striking modifications of a bird foot is found in the little Chinese jacana, which is a water bird in its haunts and habits and yet is not so in appearance. Its food is found for the most part on the leaves of the aquatic weeds which rise above the surface of the water, and consists of the tiny insect life always so abundant there. Many of these aquatic plants, notably the lily, cover the surface of the water with a rank but unstable growth. No one or two of the leaves would afford a sufficient resting place for even a bird; but distribute the weight of a small bird over several of the leaves, and it could wander over the undulating surface with perfect safety. The toes of the jacana are so disproportionately elongated that the desired condition is attained, and it can pass securely over a carpet of floating weeds where a lighter bird, lacking the elongated toes, would sink at once into the water. The jacana endures the water well enough, but it is on the surface and not in the water that it finds its food. When alarmed, it dives at once into the water and swims some distance before coming up. And even then it does not come fairly to the surface, but merely thrusts its long bill out of water until the nostrils are exposed, and so hidden it remains until danger is past.

Even among the web-footed swimming birds there are notable modifications, not so much in the foot itself, as in the position of it. Those birds which confine themselves to the surface of the water are usually fair walkers on land and are among the best fliers in the bird world, while those birds which are divers and swimmers under water are, generally, poor fliers and still worse walkers. The difference in the powers of flying is due mainly to the fact that the ability to swim under water relieves the bird from the necessity of taking to the air, either for safety or for progress; but the difference in walking is the direct result of that modification which makes the bird a good diver and sub-aquatic swimmer, and the better the diver, the poorer the walker, the one quality following so closely on the heels of the other that it is safe to say the best diver is hardly able to walk at all. This is because the feet in the divers are put so far back on the body. A familiar instance of the working of this rule is seen in our common geese and ducks. The latter, with their feet nearer the tail than the former, are much clumsier than they. And in some cases, as with the auk and penguin, the feet are placed so far back that the bird is forced to stand erect in order to progress at all in walking, and even then it does so with extreme difficulty.

A Soap Bubble Diffusiometer.

At the recent *soiree* of the Royal Society, the principal feature of the evening was the soap bubble experiments of Mr. C. V. Boys. One of these afforded a beautiful illustration of the phenomenon of the diffusion of gases. A spherical bubble was blown on to a fixed ring of wire, and within it a smaller free spherical bubble was blown of a mixture of gas and air. This bubble rose and floated near the top of the inclosing bubble, but without coalescing with it, owing to the presence of the intervening layer of air, which prevented actual contact between the two soap films. The whole was then inclosed under a bell glass, to which a current of coal gas was admitted. In a few seconds the inner bubble left the upper part of the larger bubble, and after floating about in it for a short time, descended, and finally rested on the bottom; thus showing that diffusion had taken place through the films, and that the specific gravity of the contents of the bubbles was consequently equalized. This proof of the reality of the diffusion of gases through such a medium as a soap film, which remains intact the while, is a very striking one; and it can be modified in a variety of ways. Thus a soap bubble was blown with pure oxygen gas, and immersed for a few seconds in a bell glass containing the invisible vapor of ether. When the bubble was withdrawn and approached to a flame, it exploded with a flame and report, showing that during the short time of its exposnre to the ether vapor, diffusion had occurred, and the original filling of pure oxygen had given place to an explosive mixture of oxygen with the ether.—*The Journal of Gas Lighting.*

PHOTOGRAPHIC NOTES.

To Impart a Beautiful Brown Tone to Platinotypes.—According to a communication of M. Taeschler-Signer, in the *Rundschau*, a beautiful brown tone may be imparted to platinotypes, if to a hot solution of potassium oxalate a solution of bichloride of mercury is added before development.

Solution A.

Potassium oxalate	295 grammes.
Water	1,000 c. c.

Solution B.

Bichloride of mercury	5 grammes.
Water	100 c. c.

Solution A is warmed up to 158° to 176° F., then solution B is added. According as more or less bichloride of mercury is added, the tone may be altered from the common grayish blue to brown, even to sepia color. This method may be a good one for those who prefer the brown tone to the dull engraving color of platinotypes, but to my mind the permanence of the pictures will run risk by adding mercury bichloride. It is well known to photographic operators that negatives having been intensified by means of bichloride of mercury and ammonia, after continued exposure to light, after about eight days, commence to bleach if looked at by reflected light.

Excellent Toning Bath for Albumen Prints.—The following is recommended by James Bourier, in the *Amateur Photographer:*

Distilled water	1,200 c. c.
Carbonate of soda	5 grammes.
Benzoic acid	10 "
Gold chloride (brown)	1 gramme.

No other gold bath has given to the author such beautiful, warm, velvet-like tones as the above, which has also the advantage to keep very long. The natural benzoic acid, produced of gum benzoin, is, however, rather dear, while benzoic acid "extoluol" (a compound of the coal tar oil) is much cheaper, and as good as the natural one. The benzoic acid being lighter than water, floats upon the latter, and the bottle in which the gold bath is made must, therefore, often be shaken, to cause the crystals to dissolve.—*H. Gunther, in Photographic News.*

Lacquer for Iron and Steel.

A new preservative of iron and steel has been found in a modification of the well known Japanese gum lacquer. After many experiments, the preparation has been finally adopted for the imperial Japanese navy. There is a certain difference between the compound prepared for painting iron and steel and the ordinary lacquer employed for wood, but its principal element is still the gum lacquer. The inventor of the new composition had great difficulty in conquering the tendency of this material to get very hard and then to crack, but, according to the reports, he has succeeded at last. Experience has shown that a ship protected with this variety of lacquer has been able to keep afloat in tropical seas for three years—going into dry dock only once instead of six times during that time, as usual. A ship of the Russian Pacific squadron has tried the new coating, and the result has been very satisfactory. It is consequently thought that at last a tolerably perfect anti-corrosive coating for iron and steel structures has been discovered, which may render substantial service in the preservation of all descriptions of erections in these materials. The first cost of the preparation is rather high, but it is claimed that the excess of cost is more than compensated by the protection obtained. For ship use it is also asserted that great advantage accrues from the high polish which this lacquer retains while the coating remains perfect, but, on the other hand, fears are expressed that the supply of gum lacquer will be unequal to the demand, if the requirements for these engineering purposes are added to the regular consumption of the article for ornamental joinery and cabinet work.

Coloration of Flame by Elements.

Herr Cracau points out as a point probably worthy of further investigation (*Der Pharmaceut*, Sept. 15, p. 116) that certain elements resembling each other in chemical properties impart colors to flame that are complementary. For instance, potassium and sodium resemble one another in chemical properties, and the former imparts to flame a violet and the latter a yellow color, the two colors being complementary; barium and strontium also resemble each other chemically, and the one colors flame green and the other red; and a similar remark applies to zinc and cadmium. Herr Cracau also thinks it suggestive that the colorations produced by potassium and calcium, both of which lie under suspicion as to their true elementary character, are of a compound character, the one being violet, a combination of blue and red, and the other orange, a combination of red and yellow.