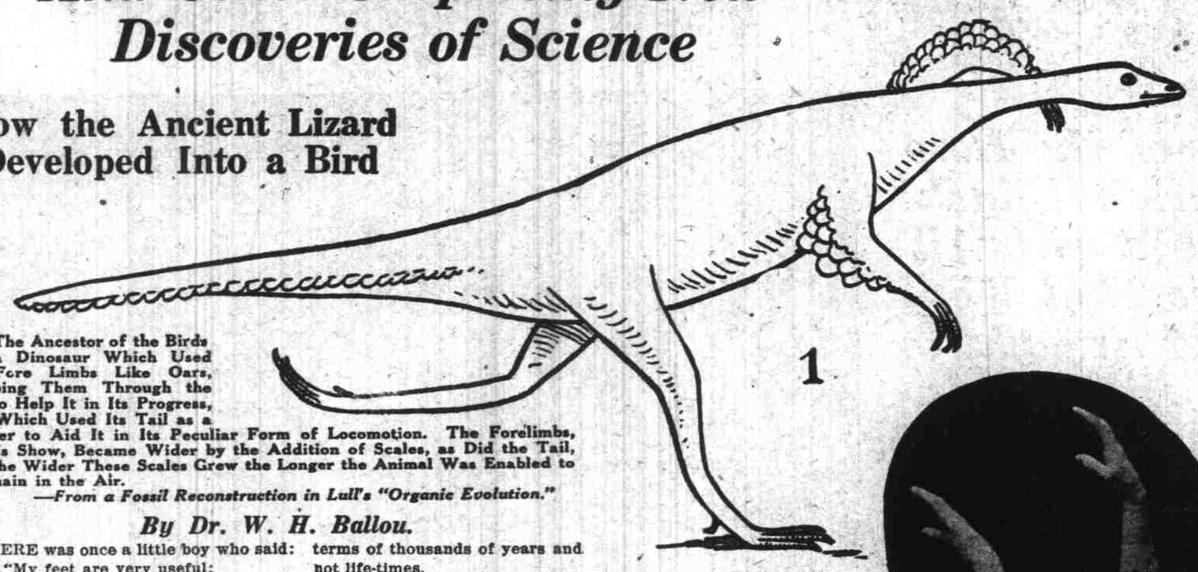
WHY—

1—The Soles of Our Feet Have the Thickest Skin
2—A New Baby Looks Like Both Sides of Its Family
3—The Shape of Our Toes Is Not Caused by Tight Shoes
4—The Fantastic Big Prehistoric Lizards Turned Into Birds
5—A Violinist's Son Can't Inherit His Father's Toughened Fingers
6—BUT a Wart-Hog Can and Does Inherit Tough Knees
7—Most Men Have Hair on Their Chests—

And Other Surprising New Discoveries of Science

How the Ancient Lizard Developed Into a Bird



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1—The Ancestor of the Birds a Dinosaur Which Used Its Fore Limbs Like Oars, Flapping Them Through the Air to Help It in Its Progress, and Which Used Its Tail as a Rudder to Aid It in Its Peculiar Form of Locomotion. The Forelimbs, Fossils Show, Became Wider by the Addition of Scales, as Did the Tail, and the Wider These Scales Grew the Longer the Animal Was Enabled to Remain in the Air.

—From a Fossil Reconstruction in Lull's "Organic Evolution."

2

2—The Tetrapteryx, the Missing Link Between the Dinosaurs and the Birds. The Scales Have Turned After Ages Into Feathers on the Forelimbs, Which Still, However, Retain the Claws. The Tail Has Become Flatter and Also Feathered, and the Bones and Muscles of the Hind Legs Have Dwindled in Size Through Disuse, While Their Scales Have Become Feathered Planes.

3

—The Modern Bird. All Trace of Claws Has Disappeared from Its Wings, While Its Legs Have Become Simply Structures to Allow It to Hop, to Walk More or Less Awkwardly and to Thrust Itself Into the Air for Flight.

By Dr. W. H. Ballou.

THERE was once a little boy who said:

"My feet are very useful;
I put them on the ground,
Then all I do is steer them
And they take me all around."

This naive, unquestioning point of view as interpreted by Gellett Burgess is common more or less to all of us. We take our bodies with their complexities and their scores of highly specialized mechanisms for granted, seldom seeking to go beyond the returns. But if the little boy, still considering the usefulness of his feet, should have been impelled to ask: "Where did I get 'em?" science would have imparted to him a wealth of curious facts, among them that if it had not been for a series of interesting accidents his feet might still be toeless flappers, useful only in propelling him around in mud or water. And if that were the case he wouldn't be a little boy at all, but a little mud puppy!

The science of yesterday could have told him that, but the science of to-day, after going carefully over the body, both inside and out, has just listed 2,500 "traits" which we can inherit from our ancestors from below the lizard up through the ape form to the cave man and beyond. And in doing so it has thrown absolutely new light upon the origin of all kinds of familiar things we carry about with us.

Some of these are catalogued by Dr. Herbert E. Walter, of the Chair of Biology Brown University, in his new book, "Genetics."

It is commonly supposed that the skin on the soles of our feet is thicker than the skin elsewhere, because we walk upon them, or, as the little boy would say, "steer them to take us around." But this is not so. The thickness of the soles is due to the fact that the amphibian form, called the mud puppy, one of the forms of man in his ascent to what he is to-day, had thickened soles. Our feet changed in shape during the ages, but never gave up the thickened skin. We can and do make it thicker by walking—but even if we never walked it would still be thicker than the other cuticle.

These few square inches of thickened sole are the link between the crawling amphibian of world youth and the most fairylike, graceful dancer of to-day, a proof of their kinship.

It takes ages to fix a trait so that it becomes inheritable. We enter life within this composite mechanism we call the body. What we inherit are its parts. We cannot inherit what our father or mother did with any of its parts. That is why the son of a violinist cannot inherit the callosities on the left hand produced by pressing down the strings.

On the other hand, observes Dr. Walter, the characteristic callosities on the knees of the wart-hog, phacechoerus, which are also apparently the result of use, are inherited by the young. "It has been noticed," he says, "that the young wart-hogs as soon as they are born possess the callosities, so that this instance looks like one of inheritance of a character acquired through use or exercise."

The explanation, as he points out, is "that these animals kneel as they root for a living in the African forests, and have done so for untold generations." Naturally, the wart-hogs who had hardest callosities could kneel longer, root harder and get more food. Those who hadn't would get less food, be weaker and not be able to cope with the stronger for mates. The tendency would be to develop the callosities, and in time they would be transmitted—just as the elephant's trunk was developed from the long upper lip of the primitive form and became inheritable. But it would take ages of violinists to transmit the characteristic callosities to a child. Nature, in inheritance, works in terms of thousands of years and not life-times.

This is fortunate, continues Dr. Walter, for if it were not so the sons of warriors would inherit their fathers' scars and we would be a race of cripples.

"The progressive degeneration or crippling of the little toe in man has long been explained as the inheritance of the cramping effect of shoes upon generations of shoe wearers," he says. "But this is not so; we must look elsewhere for the cause. As Wiedersheim has pointed out, the fact that Egyptian mummies show the same crippling of the little toe is unfavorable to this hypothesis, for no ancient Egyptian could ever be accused of wearing shoes or of having had shoe wearing ancestors.

"The feet of Chinese women of certain classes have for centuries been mutilated into deformity by bandaging, without the mutilation in any way becoming an inherited character. Sheep and horses with docked tails, as well as dogs with trimmed ears, never produce young having the parental deformity. Weismann's classic experiments with mice, an experiment subsequently confirmed by others, is additional negative evidence upon this same point. What Weismann did was to breed mice whose tails had been cut off short at birth. He continued this decaudilization through twenty-two generations with absolutely no effect upon the tail length of the new born mice. One may see in the catacombs of the Zoologisches Institute at Freiberg, filed carefully away on shelves as a document, long rows of labelled bottles containing the fifteen hundred and ninety-two martyrs to science which made up the twenty-two generations.

"Conklin has hit the nail on the head with respect to mutilations by saying: 'Wooden legs are not inherited, but wooden heads are.'"

Walter does not mention the common foot corn, but it has recently been established by long study of domestic animals and humans that these are not acquired from tight shoes, but are inherited. Shoes irritate, but do not cause. The callosity that comes from pressure on any other part of the body and the foot corn are entirely different things. The true corn is a parasite of unusual order. In its inception and growth it parallels the fungus known as the genus fomes, which forms on a tree and every year grows a new layer on top. The process continues as long as the tree lives, which is to say until the fungus has so extended its mycelium, or plant, to absorb all the food of the tree.

A corn goes through the same process, extending its fine threads or roots, however, only to the bottom of the toe. It has an entity of its own, as sure as an insect, but without the power of movement. The elephant inherits corns from its ancient ancestors, the paleomastodon and the maeritherium. Its spore has its place, apparently, in the germ plan of the animal cell.

When the proud families of a new mother and father gather around the baby and each one discovers to its secret delight that the baby looks just like John and looks just like Annie—how can that be?

The answer is that it really does. It also looks just like John's and Annie's parents and grandparents and great-grandparents. It is really a composite and the eye of hopeful imagination picks out the points of resemblance it wants to—and is perfectly right in seeing them there. It is only later on that it begins definitely to look like one side of the family or another—or in parts like both. From the composite the dominant character or stamp strengthens as the days go by, submerging the weaker lines.

Dr. Richard Swann Lull, professor of vertebrate paleontology at Yale University, has some new and interesting theories on how we got what we have in his newest work, "Organic Evolution." Why do most men have hairy chests, but not hairy backs? Professor Lull hazards the explanation that this is not only due to the acquisition of artificial clothing, but to the way clothes were first worn—to primitive fashion, in fact. He cites Matthews for evidence of this belief. Of course, humanity back in its ape-like stage, was wholly hairy—as hirsuted as is the gorilla or the chimpanzee to-day.

"The loss of hair in man," says Matthews, "is accompanied by an exceptional and progressive delicacy of skin quite unsuited to travel in tropical forests. I do not know of any thin-haired or hairless tropical animal whose skin is not more or less thickened for protection against chafing, the attacks of insects, etc. Second, the loss of hair is most complete on the back and abdomen. The arms and the legs, and in the male, the chest, retain hair much more persistently.

"This is just what would naturally happen if the loss of hair were due to the wearing of clothes, at first and for a long time, a skin thrown over the shoulders and tied around the waist. If the loss of hair were conditioned by climate it should, as it invariably does among animals, disappear first on the under side of the body and the limbs, and be retained longest on the back and shoulders."

It would seem to the writer that this is entirely sound, and can be explained further by the exigencies of the time. The male would use the skin for protection. He would need to have his arms and hands free for offense and defense. He would naturally wear the skin thrown over his back.

A suggested reason for the difference in this respect between man and woman of to-day—that is the almost uniformly smooth breast of the latter—is that the female, protected by a male, would not need her hands and arms for the using or carrying of arms. Woman was at first more completely clothed than man—although with civilization she has departed from the ancient habit. The necessity of carrying her young at breast would also demand further protection for the front of the body—a necessity to which the male was stranger.

Going further back than the time we have just discussed, Lull makes another curious observation about the hair. This is the reason for its direction. That upon the arms, for instance, runs from shoulder to elbow and from the wrist upward and outward in such a way that, were the hands clasped above the head with the elbows pointing downward, a posture often assumed by the orang, the hair thus arranged sheds the falling rain.

"In all anthropoids except the gibbon the same direction of hair prevails," says Lull, "as with mankind, hence the conclusion of a bygone community of habit between man and these apes is irresistible."

In other words, man lost his hair by putting on clothes—but the hair that is left sticks to the old ways before clothes, just as the thickened foot sole sticks to the far older ways ages before what became man had hair.

One of the most interesting reconstructions is not only the theory of how the prehistoric lizards turned into birds, but an actual picture of their first ancestor. This has been done by Professor Lull. He quotes the famous Hungarian paleontologist, Francis Baron Nopcsa. Nopcsa does not believe that bats and the ancient monster flying lizards, the pterodactyls on the one side and feathered birds on the other, arose in the same way. He points out that the former fly by means of membranes and the latter by means of feathers, and that the first must always adapt both their fore and hind limbs and tail to the support of the membrane, whereas in a feathered animal only the feather supporting elements need become affected by flying specialization.

The hind limbs of birds are so similar in structure to those of certain dinosaurs that the inference must be made that birds came up from two-legged, long-tailed running reptiles which, during their progress, coasted along in the air by flapping their free front limbs. These free front limbs or arms would, of course, be more effective if their breadth could in some way be increased to give a greater bearing surface—in just the same way that, all things being equal, an aeroplane can go through the air better with bigger planes than smaller ones. An increase in the size of the scales along the arm margin would be a ready means to this end. The fossils show such an increase actually took place.

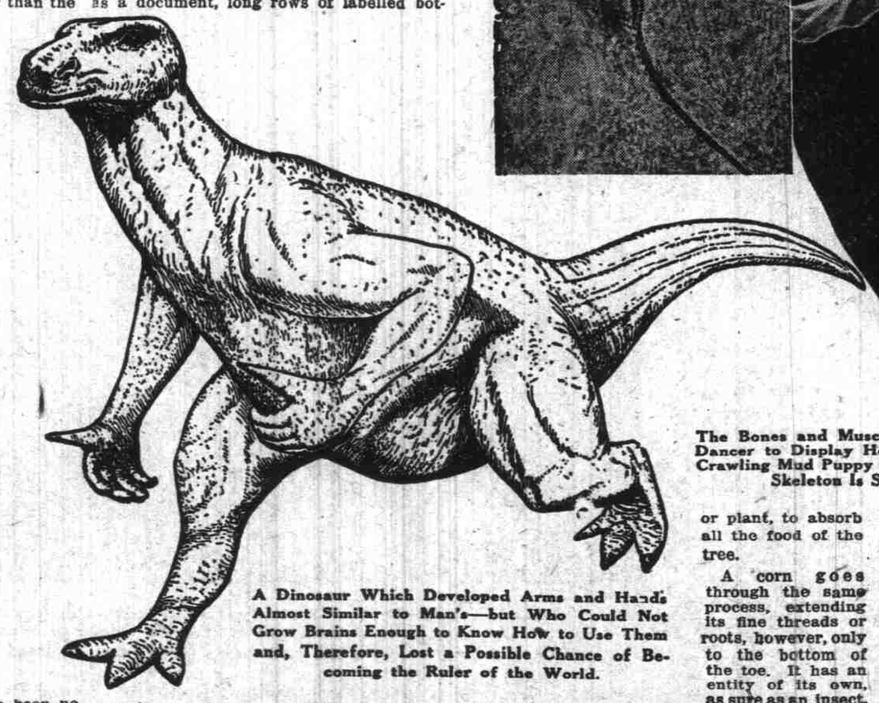
Similar scales might develop along the margins of the tail—and did. These scales would in time extend, lighten and ultimately evolve into feathers which would not only increase the function of flight but, acting as clothing, retain and aid in the increase of temperature. This in turn would help to improve both the mental and the physical activities of these forms, making them into hot blooded animals instead of cold, and this is sufficient reason for the dominance of birds over all other aerial rivals, such as the bat, the flying squirrel, etc., and for their survival after the extinction of their dinosaurian kindred.

As time went on the scales, as shown on figure one in the drawings at the top of this page, would increase largely; at the same time, as they increased the animal would be more in the air than on the ground and, therefore, its hind legs would begin to grow smaller and more slender. The time would come at last when they would become largely adapted for hopping off the ground to give the creature the impetus to allow it to fly and soar.

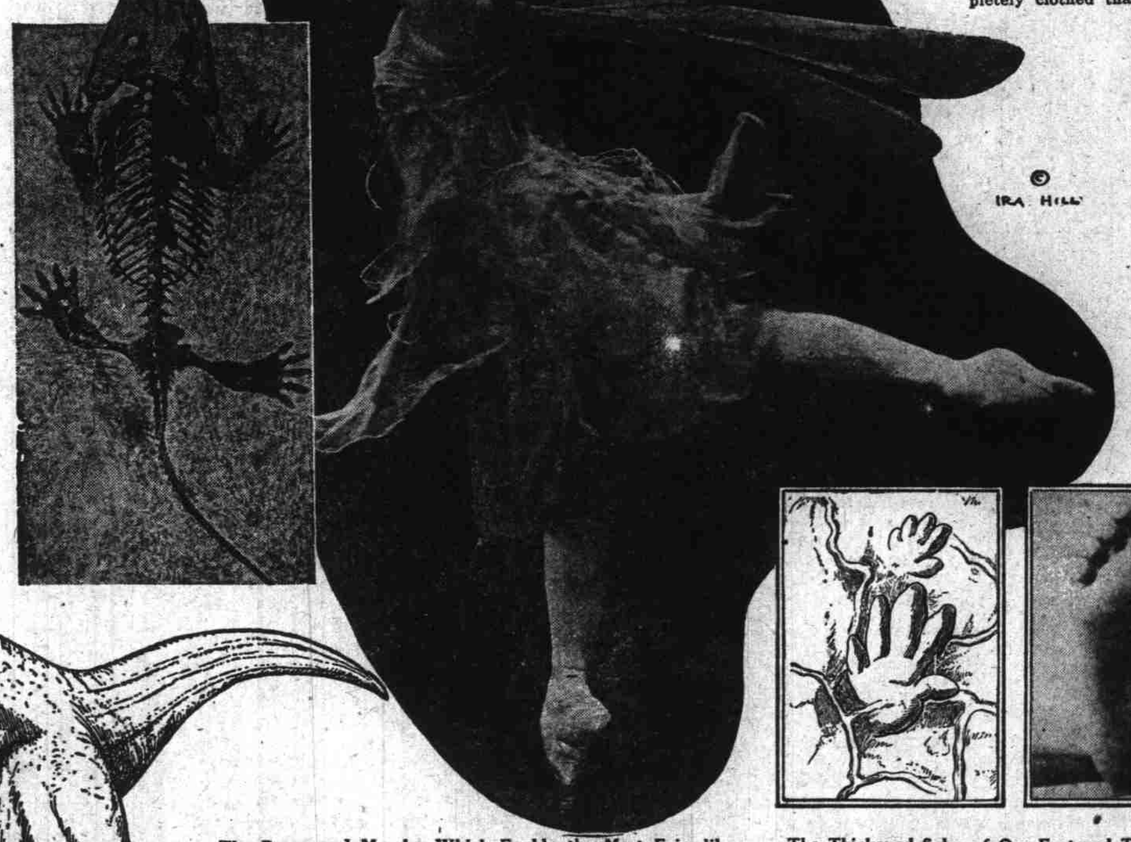
Just as we would expect under such conditions we have a fossil record of an intermediate form in the tetrapteryx. This was a four-winged, decidedly reptilian bird. By the reconstruction, No. 2, it will be seen that in it the forelimbs of No. 1 have become profoundly modified, but still retain the claws on the ends. The hind limbs have also become modified and the tail is entirely feathered. In No. 3 we have the modern bird, in which the hopping legs of the old dinosaur ancestor are reduced to the clutching, jumping ones so familiar to us in all birds of to-day, and in which the fore limbs, by reason of their specialization, have lost all semblance to the scaled members of the lizard form from which they sprang.

In a way of speaking, the birds developed wings and feathers because they had brains enough to use the scales which they acquired during a certain period of development.

And here is a very curious little lesson of what happens when things do not develop brains and use what they have. The running monster is known as iguanodon. It lived in the Cretaceous Age, millions of years ago, in Belgium and on the Isle of Wight. It developed, as its fossils show, arms and hands almost exactly similar to the human arm and hand of to-day, but it never developed a brain big enough to know how to use them. All it did with them was tear and cut and slay. The consequence was that after a few thousands of years iguanodon died out. If there had only been a brain which would have enabled it to use its hands for making fires and so on, as our primitive ancestors did, the story of the dominant race on earth might have been very different—for this dinosaur lived a million years before the first ape-like creature which was to turn into man began to appear on the face of the planet.



A Dinosaur Which Developed Arms and Hands Almost Similar to Man's—but Who Could Not Grow Brains Enough to Know How to Use Them and, Therefore, Lost a Possible Chance of Becoming the Ruler of the World.



The Bones and Muscles Which Enable the Most Fairy-like Dancer to Display Her Art Came Down Directly from the Crawling Mud Puppy of Millions of Years Ago, Whose Fossil Skeleton Is Shown Here Beside the Dancer.

The Thickened Soles of Our Feet and Their Toes Are Descended Directly from the Crawling Amphibians, Two of Whose Footsteps Are Shown Here Preserved on a Slab of Sandstone.