From fish to frog? Not by the skin

Mark Armitage and Frank Sherwin

Neo-Darwinian theory predicts 'finely graduated organic change' (Darwin's own words) between groups of organisms as they descend with modification. If amphibians evolved from fish, then it would be reasonable to assume that, at the ultrastructural level, the skin of a frog would be similar to that of a fish. Skin from *Xenopus laevis* (frog) and *Carassius auratus* (goldfish) was harvested and processed for transmission electron microscopy (TEM). These two types of skin are dramatically different in many ways. Frogs use sophisticated structures such as mitochondria and well-designed active ion transport systems in their skin that fish simply do not have. Additionally, fish skin is completely anchored to bone in an elegant manner, using sheets of helically arranged collagen fibres to provide for rapid swimming. Frogs respire mostly through their skin, but they have lungs as well, whereas most fish breathe only through gills.

Secular scientists require purely naturalistic explanations for the origin of all biological organisms. Thus, features that are displayed in the animal kingdom, such as fins on fish and limbs on frogs, must have arisen by stochastic mechanistic processes, and not by any design parameters or intelligent planning.

Darwinism maintains that the slow (or even punctuated) progression of 'simple' life to 'complex' life did occur, and that evidence of this is supposedly recorded in the sedimentary rock units found encompassing the earth today. Unearthing the fossilized remains of supposed transitional organisms, however, is another matter.

Darwin himself was vexed in his own day by the lack of such fundamental evidence for his poorly received theory. He wrote:

> '… intermediate links? Geology assuredly does not reveal any such finely graduated organic change, and this is perhaps the most obvious and serious objection which can be urged against the theory [of evolution].'[1]

The fossils studied in Darwin's time revealed the same pattern that we observe today, and he prophetically lamented over it by writing:

> 'Firstly, why, if species have descended from other species by insensibly fine gradations, do we not see innumerable transitional forms? Why is not all nature in confusion instead of the species being, as we see them, well defined?'[1]

What we have observed over the past 145 years of digging is that the species (or rather, created kinds) are still 'well defined'.

Darwin was undeterred, suggesting that by continued investigation of the sedimentary units 'his' theory would be vindicated. In the case of fish-to-amphibian transition, one wonders today if modern paleontology has once and for all revealed the critical link(s) between fish and frog.

Not according to molecular biologist Michael Denton, who has written:

> 'Take, for example, the way the various fish groups make their appearance. In the space of less than fifty million years, starting about four hundred million years ago, a high proportion of all known fish groups appear in the fossil record … the pattern repeats itself in the emergence of the amphibian. Over a period of about fifty million years, beginning about three hundred and fifty million years ago, a number of archaic and now extinct groups of amphibia make their appearance as fossils.'[2]

Vertebrate paleontologist Barbara Stahl writes, regarding the very origin of fishes:

> 'The origin of all these fishes is obscure … it is not possible to demonstrate unequivocally the descent of any group of the higher fishes from a

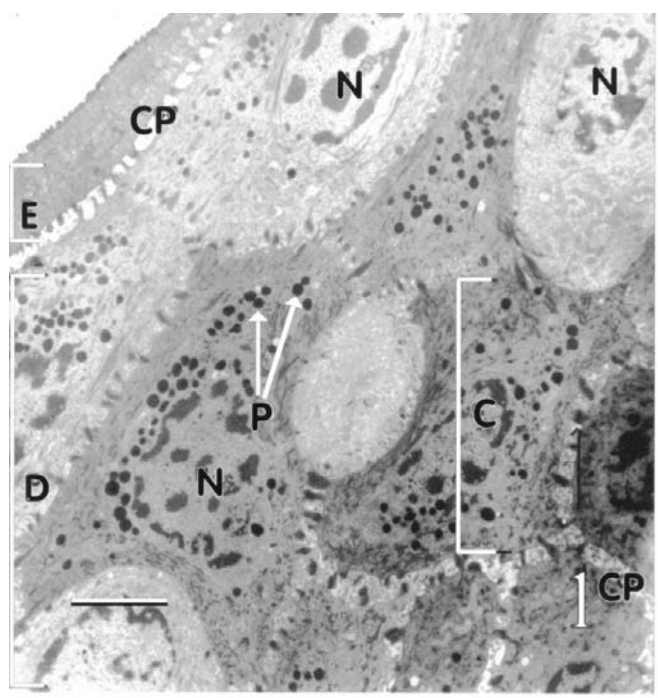

Figure 1. *Frog skin showing epidermis (outer layer) and dermis (inner layer). Several large nuclei are seen with darkly stained chromatin (chromosomal material) within. The cytoplasmic processes are communication connections between cells. The large, dark chromatophore (a cell which makes skin pigment) is seen at the lower right. Scale bar = 1.5 microns. E= epidermal layer. D= dermal layer. CP= cytoplasmic processes. N = nucleus. P = pigment. C = chromatophore.*

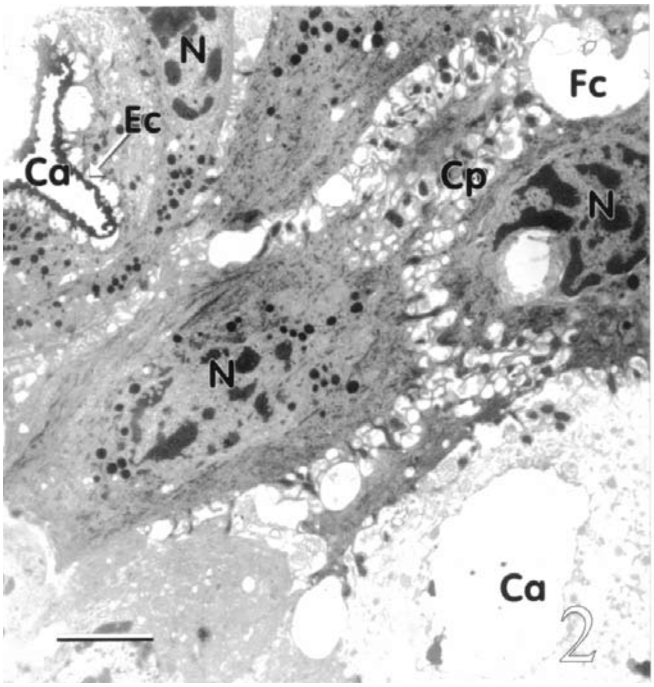

Figure 2. Frog skin dermis (i.e. deeper within the skin). Two capillaries, which transport blood into the tissues, are seen. In the capillary on the left, the cells that line the inside of the capillary (endothelial cells) are seen. The fat cell (upper right) is a storage cell containing triglycerides, which are used to generate body heat. Scale bar = 1.5 microns. Ca = capillaries. Ec = endothelial cells. Fc = fat cell. N = nucleus. Cp = cytoplasmic processes.

specific stock of placoderms or acanthodians.'[3]

Gordon Rattray Taylor, famed BBC science editor has stated with respect to amphibians:

> 'There are no intermediate forms between finned and limbed creatures in the fossil collections of the world.'[4]

Now it is impossible for even the most avid professional paleontologist to stay abreast of even the most recent quotes by experts in this field. However, lest anyone criticize us for using dated quotations, we suggest that this confusion yet reigns today. For example, Meyer and Zardoya have recently written:

> 'Although most recent morphological and paleontological evidence supports lungfishes as the closest living sistergroup of tetrapods, until recently there was no general agreement regarding which group of living lobe-finned fishes, the Actinistia or the Dipnomorpha, is the one most closely related to the tetrapod lineage. There is still disagreement among paleontologists about the homology of some important characters (e.g. the choanae) and relevant fossils of intermediate forms connecting the three groups still await discovery.'[5]

The supposed change from fin to leg is not seen in the rocks. Additionally, the supposed genetic mechanism effecting such a fantastic transition has yet to be discovered and explained.

It has often been suggested that the link between these two clearly defined groups is the crossopterygian (lobe-finned) fishes. These fish were supposed to have evolved into the ichthyostegid amphibians. But the crossopterygians were anatomically unique (e.g. their skeleton and internal organs were markedly different). Major changes would have had to occur in just the right order to make the complete transition to an amphibian. For example, the pelvic girdle must have gradually (and perfectly) formed by random mutations. The marvellously formed gills must have also slowly degenerated as the air sacs used for singing/croaking supposedly developed into advanced oxygen gathering lungs. But what about the skin of such different organisms? Would it be reasonable to assume that the skin of a fish would be similar to that of a frog? Maybe fish skin under high magnification shows the rudimentary features of the marvellous structures that amphibians employ today, such as the ability to breathe through their skin.

We harvested and processed skin from a common goldfish (*Carassius auratus*) and a common frog (*Xenopus laevis*) to study the similarities and differences between them. Specimens were processed according to standard TEM (Transmission Electron Microscopy) microtechnique.[6] Images were recorded on an AEI EM 801 at 80 kV.

Frog skin under TEM (see figures 1–4)

Anuran (frog) integument, or skin, is very complex, and is comprised of two major parts, a mucus-covered epidermis and an underlying dermis. This mucus is composed primarily of glycoproteins, and forms a slimy protective coat

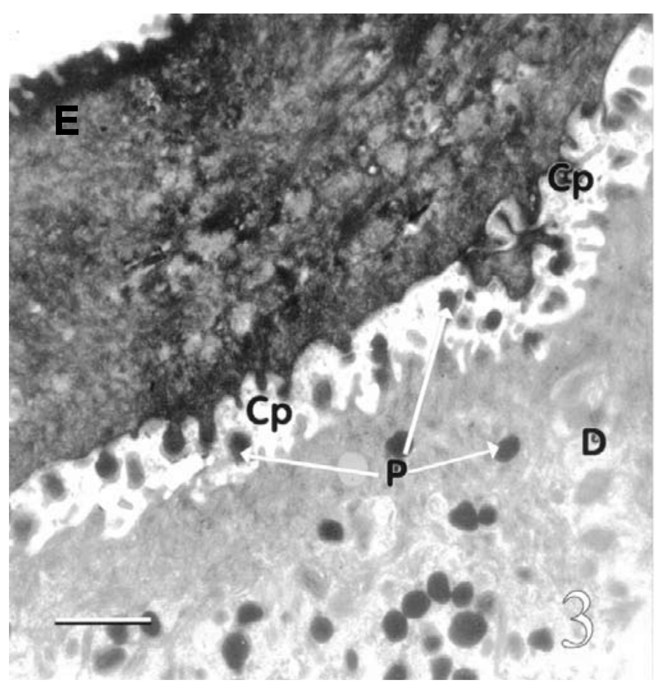

Figure 3. Frog skin, highly magnified epidermis. Here the fine structure of the cytoplasmic processes is more apparent. Pigment granules are also seen migrating from the dermis (lower right) into the epidermis (upper left). Scale bar = 0.75 microns. P = pigment. D = desmosome. Cp =cytoplasmic processes. E = epidermis.

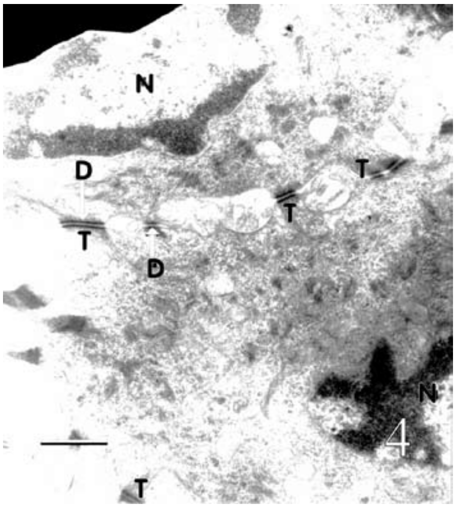

Figure 4. Frog skin, cell-to-cell anchorage. Because the epidermis must withstand strong abrasive forces, cells in the epidermis are bound to each other by desmosomes through which tiny filaments called tonofibrils are knitted. Tonofibrils extend into each cell much like girders hold together tall buildings. Scale bar = 0.5 microns. D = desmosome. N = nucleus. T = tonofibrils.

over the entire outer surface of the animal. The function of this mucus is to keep the skin moist, to prevent infection (from fungi, bacteria, prokaryotes and multicellular parasites, especially since it contains highly active antibodies or immunoglobins to fight off such invaders), to assist in osmoregulation (the regulation of water and salts within the tissues), and, most importantly, to effect respiration.

The dermis is made up of an outer loose layer, which contains fibrous connective tissue, blood vessels and chromatophores (specialized pigment cells) and an inner deeper dermis, which is denser and which anchors the dermis to the underlying muscle (see figures 1, 2 and 3). In the case of anurans, the blood vessel supply to the very epidermis provides for uptake of oxygen directly from water. Additionally, the epidermis is richly populated with mitochondria and is very much involved in the active transport of ions across its surface.[7] This arrangement allows for cutaneous respiration in which the skin is the main respiratory organ of the organism. As mentioned, the epidermis is richly supplied with tiny blood vessels (capillaries), derived from the dermis (figure 2). This allows for gas exchange to occur across the respiratory surface of the skin because the capillaries migrating through the deeper epidermis and dermis transport oxygen-rich blood to body organs. These capillaries also excrete carbon dioxide to the environment that the frog finds itself in.

Anurans and other amphibians use specialized glands and accompanying ducts to secrete mucus, and in some cases, even poison. Both kinds of glands are found in the dermis, and their respective ducts open to the surface through the epidermis.

The chromatophores, found within the dermis and epidermis, are responsible for the synthesis and storage of pigment, or colouring, within amphibian integument (figures 1 and 3). This aids in camouflage and protection from predators. Additionally, it serves as a warning to prospective enemies that its owner may harbour a toxic poison. The intensity of the colour of amphibians is determined by how much pigment migrates to the epidermis. Also, it is not unusual to find chromatophores in the walls of the digestive tract, within the mesenteries, or around the reproductive organs. There, pigment may serve to protect these deeper layers from harmful radiation from the sun.

Fish skin under TEM (see figures 5–8)

The integumentary system, or skin, of the typical fish is also composed of two layers, a thin outer epidermis and an underlying dermis (figures 5 and 6). The epidermis lacks scales (they arise from the dermis) and is divided into an outer layer composed of stratified squamous cells (which are constantly worn away by wear and tear), and a basal layer. The outer layer contains hardened, dead, keratinized cells, which help to reduce water loss and can add oils, waxes and lipids to waterproof the skin of fish. Indeed several large lipid droplets and open spaces that held large lipids are readily seen in figures 6 and 7. These thick layers of lipids are not found in frog skin. The thickness of the fish epidermis is generally greatest on the dorsal surface and toward the head of a typical fish.

There is little active transport: thus, mitochondria are almost absent in comparison to frog epidermis. Thus, at the very outermost layer of skin, we begin to see the differences between fish and frog.

Special glands such as granular cells, goblet cells and club cells in the epidermis secrete a highly specialized mucous covering, as in frogs, and the mucus functions much as discussed previously, to prevent pathogens from

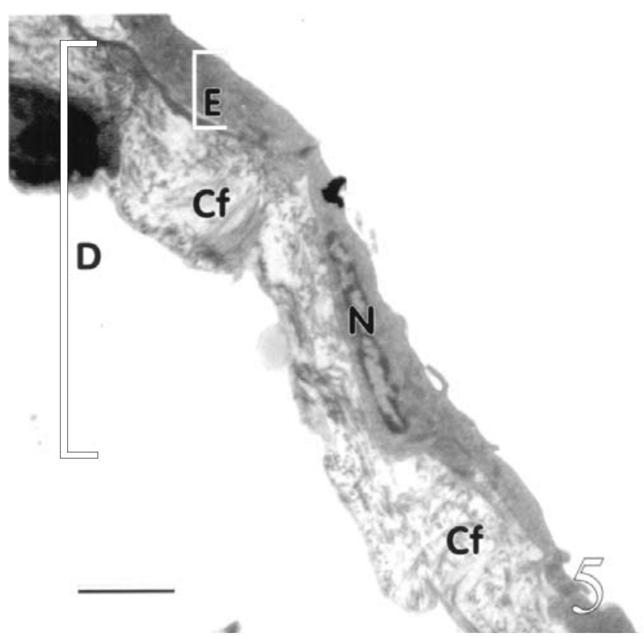

Figure 5. Fish skin. The very thin epidermis contains a flattened nucleus. Below that are seen large bundles of collagen fibres that give support and strength to the fish for rapid swimming. Scale bar = 100 microns. E = epidermis. D = dermis. N = nucleus. Cf = collagen fibres.

crossing this barrier into the skin, but it does not serve to assist in respiration. Additional functions attributed to this coat include turbulence (drag) reduction while swimming, and osmoregulation. Mucous cells often migrate to the epidermal surface after arising from undifferentiated basal cells and are sloughed off with the rest of the skin.

In addition, there are often found large, sac-like cells in the skin of some species of fish that hold secretory products within thin-walled membranes. When pierced, a toxic and/or distasteful product is released from these cells into the surrounding water, which can alert other fishes to the presence of predators. However, the kinds of poisons seen in frogs rarely exist in fish.

The dermis, although more complicated than the epidermis, serves mainly as a supportive role for the epidermis. Studies have shown, however, that the dermis contains large sheets of cross-helical collagen fibres[8,9] which are attached directly to underlying muscle and even the backbone and tail fin (figures 5 and 8). Such design resists deformation under stress and provides strength to the fish, much like layers of plywood do for house frames. Thus the entire skin is part of the swimming mechanism for fish movement. This structure is quite unlike the skin of a frog.

The dermis is composed chiefly of connective tissue fibres, along with clusters of fine blood vessels and muscle fibres. These blood vessels deliver oxygen to the dermis and sometimes the epidermis. Some fish have actually been shown to respire through their skin.[10] However, most fish breathe by extracting oxygen from the water that passes over their gills.

Not all fish have scales (e.g. the electric ray [*Torpedo*], catfish and swordfish), but for those that do, they are the most obvious structures formed by the fish integument. The teleosts (bony fish) have scales which derive from the dermis and extend outward. Scales are designed with a deep layer of vascular bony tissue, a middle layer of dentine and an outer layer of enamel. The type of enamel found in fish scales is called ganoin (or ganoine). Scales are retained throughout the life of the fish, unlike the epidermal scales of reptiles, which are cast off periodically. No such scales are found in frogs.

The outer part of the dermis also contains chromatophores, which serve to provide colour to the skin by means of pigment granules (figures 7 and 8). This colour can often take on dramatic shades and patterns, which are used to identify mates, or warn others of defensive toxins.

Problems with turning fish into amphibians

Darwinists speculate that the first vertebrates were fish, but they do not know if they had dermal scales. Additionally, as shown, much confusion reigns in the proposed ‘fish-to-frog’ evolutionary pathway. Creationists, on the other hand, maintain that amphibians were created as amphibians, and did not descend from fish or any other organism, ‘lobed’ or ‘unlobed’. In fact, all major animal (and plant) groups appear complete and fully formed in the fossil record as predicted by the Creation Model.

Frogs employ sophisticated structures such as mitochondria and active ion transport systems in their skin that fish simply do not have. Additionally, fish skin is completely anchored to bone in an elegant manner using sheets of helically arranged collagen fibres to provide for lightning-fast swimming capability. Frogs respire mostly through their skin, but they sport lungs as well. No credible mechanisms have been tendered by evolutionists to explain the loss of

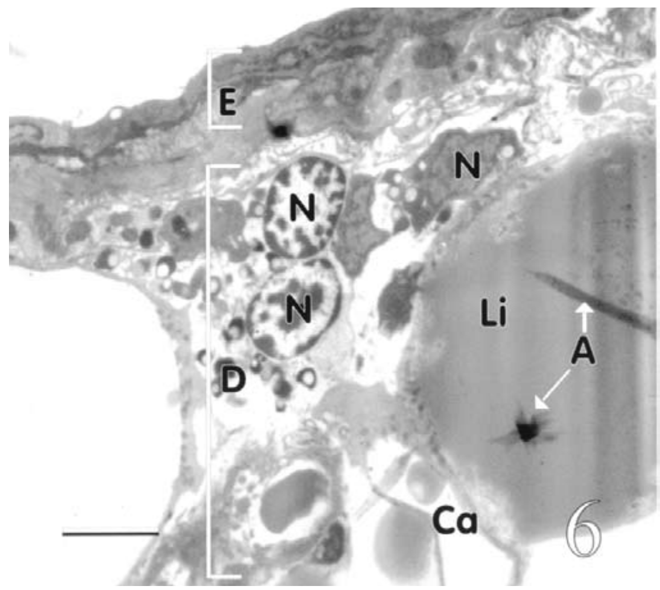

Figure 6. *Fish skin. Several nuclei with darkly stained chromatin are seen, as are the large reservoirs of lipids (Li), which insulate the fish from cold water. A capillary is seen on the lower right with a blood cell inside. The artifacts (white arrows) are due to errors in processing of the tissues and do not represent actual structures in the skin. Scale bar = 20 microns. A = artifacts. E = epidermis. D = dermis. N = nucleus. Li = lipids (fats). Ca = capillaries.*

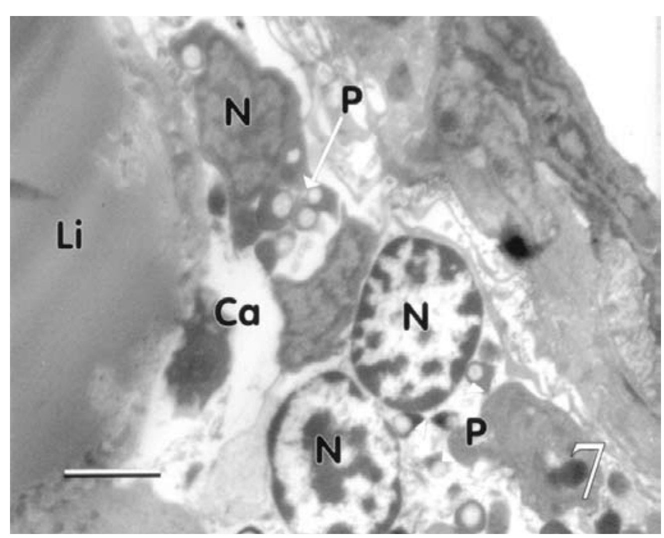

Figure 7. *Fish skin. In this micrograph, pigment granules are seen migrating from the dermis and passing between two nuclei on their way to the epidermis. Scale bar = 5 microns. N = nucleus. Li = lipids (fats). Ca = capillaries. P = pigment.*

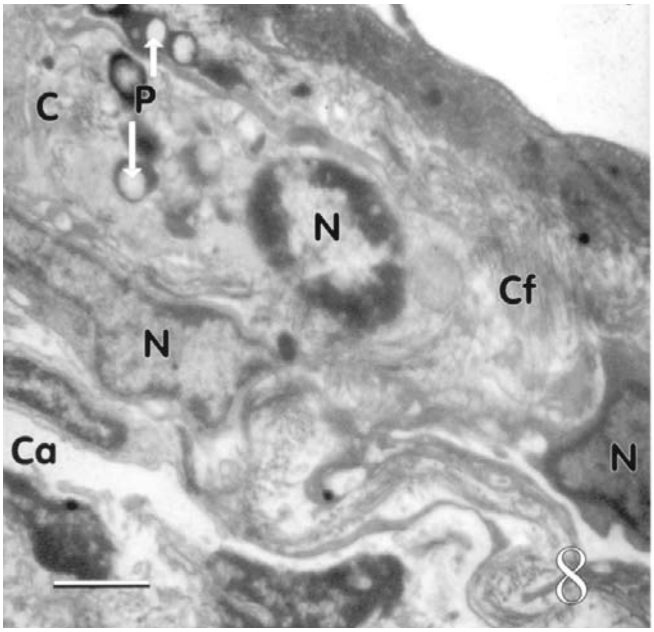

Figure 8. *Fish skin. A chromatophore (pigment-making cell) is seen at high magnification with pigment granules inside and outside of it. Scale bar = 5.0 microns. N = nucleus. Ca = capillaries. Cf = collagen fibres. P = pigment. C = chromatophore.*

gills, the loss of collagen sheets for support and swimming, the loss of a direct connection between skin and bone, the transfer to skin as a main respiratory organ, the formation of lungs, etc., etc. Fish skin is as dramatically different as it can be from frog skin, and that is what the Creation Model would predict.

It was not the evidence provided by microscopes that convinced Darwin of 'his' theory. Rather, it was the darkness of distrust and doubt of the account of creation within God's Word that made Darwin what he was. He himself wrote about how he lost his faith in the Bible:

'Disbelief crept over me at a very slow rate, but was at last complete. The rate was so slow that I felt no distress, and have never since doubted even for a single second that my conclusion was correct.'[11]

It was the slow, gradual descent of a man into doubt that evolved the story of amphibian evolution, not a slow and gradual heaping up of mutations.

We thank Dr John Morris, who first proposed this project, and the reviewers for their suggestions, which have greatly improved this work. We also give all honour and glory to the Creator, from whose mind and power the fish and frogs have come.

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