THE PENTADACTYL PLAN

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The pentadactyl plan of limb, the arrangement of limb with digits as we know it, is, as everyone knows, the regular thing among vertebrates. Evolutionists have maintained that this widespread use of the plan is evidence of a descent from a common ancestor. In this article it is shown that the plan is rather evidence of design. By consideration of many hypothetical alternate plans, it is shown that the arrangement actually found is by far the most satisfactory; and good design consists precisely of making a thing satisfactory for its purpose.

The pentadactyl plan of limb has often been cited by evolutionists as evidence of evolution through descent from a common ancestor. Having said this some go on to suggest that the plan could be bettered. Others state that it does an excellent job, and do not know whether it could be improved.

Creationists, on the other hand, have often said, with no further explanation, that the pentadactyl arrangement is a plan designed by God. Of course, that is true; but one may inquire further, whether God's design is purely arbitrary, or whether He has met the requirements for such a limb in a way not entirely unlike what a human designer or engineer might do.

In contemplating a design, it is good to keep two points in mind: "What are the materials, or components?," and: "What alternatives are there?' Let us, then, consider especially the second question. Some of the alternatives considered may be a bit far-fetched; but in design work it sometimes turns out that a seemingly far-fetched design is precisely what is needed. We need to look at the various aspects of the pentadactyl plan: variation within the plan, types of bone involved, and the mechanics of the plan itself.

Components: Types of Bone Used in the Plan

The pentadactyl limb is made up of the following. There are long bones in the arms and legs. (For definiteness, the plan as it appears in the human will be referred to.) The hands and feet are made up of "short and long bones" which are much like shorter versions of those in the arms and legs. Then, there are the joints. Also, of course, the muscles, without which the joints would be useless, should not be forgotten.

Variation Within the Plan

Variation within the plan can be seen in the various positions, proportions, and arrangements of the bones in the various organisms, all of which have limbs conforming to this basic plan. (It is not intended that any evolutionary significance be read into the use of the word "variation"; it is just noted that the plan is worked out in different ways in different creatures.)

Figure 1, for instance, shows the arrangement of bones in the flipper of a seal, the wing of a bird, and the arm of a man. It is apparent (and, of course, this is no new remark) that there is much resemblance.

Other examples of variation within a basic plan can readily be cited. For instance, consider the bones of a typical reptile and of a typical mammal. The bone cells are much larger in the mammals, having a much larger centre, surrounded by the Haversian canal. The typical reptile has what looks like mere dots, a cross-section of bone giving a freckled appearance.

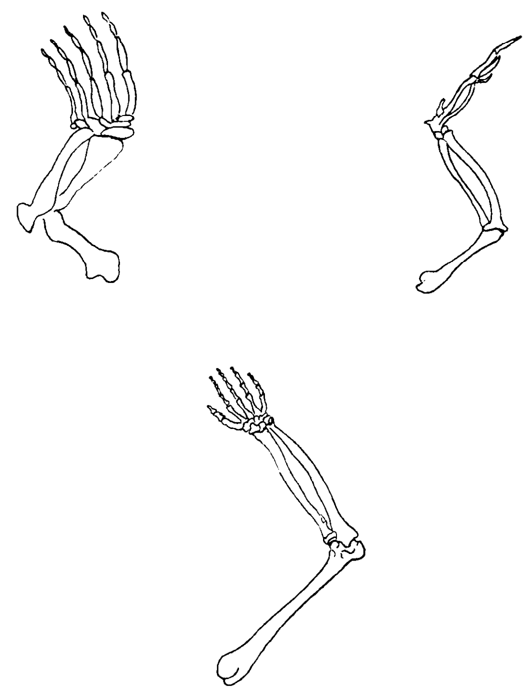

Figure 1. Variations of the limb. Upper left: seal's flipper; upper right: bird's wing; lower: man's arm. The similarity in design is apparent.

Again, the lower legs of birds have, on the bone, three articulating surfaces for the toes, a feature not found in mammals or reptiles. See Figure 2. It is worth noting, incidentally, that the archaeopteryx possessed this feature.

Some Hypothetical Alternate Models

Evolutionists cite the pentadactyl plan, common to so many creatures, as evidence of common descent; although it seems not to have been shown why, amid all the changes between amphibian and man, say, this particular feature should persist.

If, on the other hand, the plan is the best for the needs of these creatures, then it is evidence for design, rather than descent, or descent altered by random variations.

Consider, then, some of the hypothetical models suggested in Figure 3.

Model A has all long bones, with no joints. It has happened that people have been born in some such condition, having joints fused together. The only

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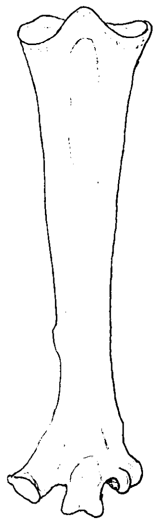

Figure 2. The lower leg-bone of a bird, showing the three articulating surfaces.

movement possible, then, would be that of the whole arm or leg; the hand or foot could not be moved separately. No one would argue that such a condition is desirable. Such a model, then, would be of no use.

Model B has joints in between the digits and in the wrist (or ankle), but no joint at the elbow (or knee). This model would be of no use.

Model C has no joint at the elbow or knee and none in the digits, although it does have a joint at the wrist or ankle. Neither would this model be of any use.

Model D has a joint at the elbow or knee and at the wrist or ankle, but none in the digits. It, too, would be of no use.

Model H is the basic plan for E, F, G, I, J, and K. Model E has two long bones and a section of "short long bones" with joints in between, a joint at the wrist or ankle and in the digits, but none at the elbow or knee.

Model F has joints at the elbow or knee, wrist and ankle, and down one side of the limb, as in model E; but it has no joints in the digits.

Model G has no joint at the wrist or ankle, but it does have joints in all other places.

The lack of joints in models E to G inclusive would render them useless; besides, we see more problems when we look at models I, J, and K.

At the back of our own leg there is a large muscle which leaves room for the knee joint to bend. In models I, J, and K, no matter where this large muscle might be placed, e.g. at the joint or above, problems arise. One side of the limb is rigid and the other has many "short long bones" with many joints. Even if the limb were to bend at all, these parts would press into the muscle and would thus hinder further movement.

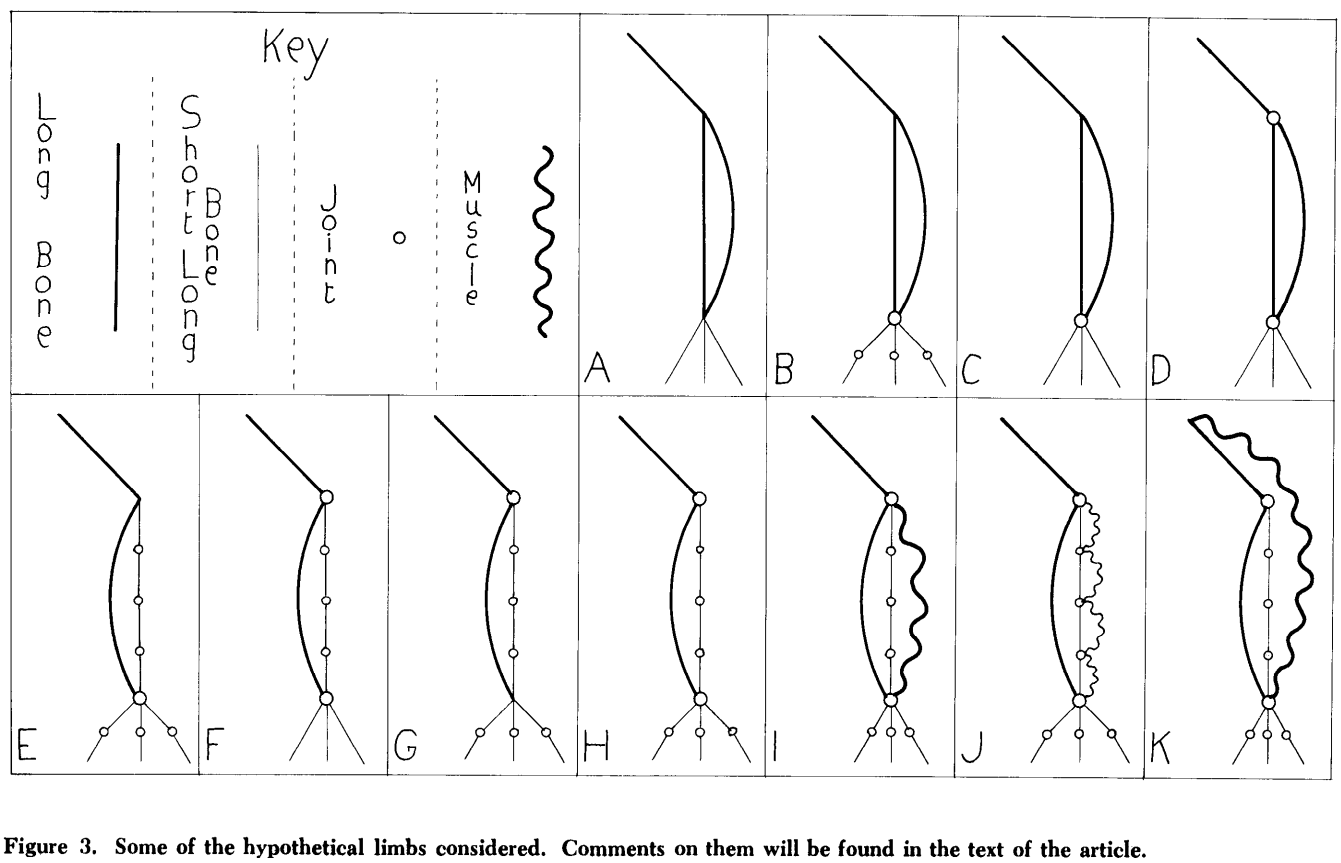

Figure 3. Some of the hypothetical limbs considered. Comments on them will be found in the text of the article.

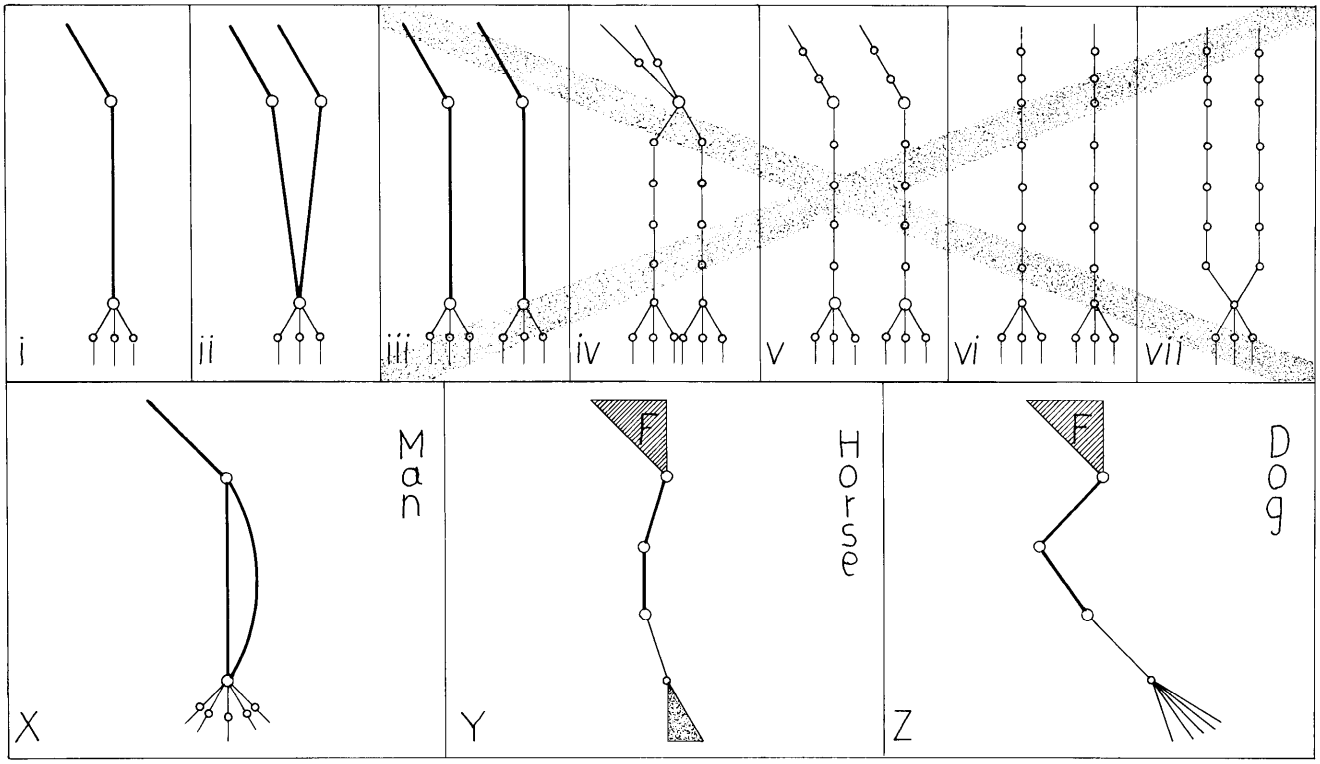

Figure 4. Parts i to vii, inclusive, show some more hypothetical limbs. Numbers iii to vii are shown crossed out (lightly) because they are so obviously unsuitable. Parts X, Y, and Z show arrangements which actually occur. The shaded triangle, marked "F," indicates a flat bone.

In model J, much smaller muscles are connected to the short long bones and between the joints. This limb would be far too weak to meet all the exigencies of life. Besides, the problems discussed for the other models would arise.

It is seen, then, that none of these hypothetical models discussed so far would be a suitable substitute for the pentadactyl model, let alone an improvement on it.

Now, let us go on to consider some of the hypothetical models suggested in Figure 4.

Models number iv, v, vi, and vii are all based on "short long bones," with a joint in between each two sections of bone. Number vii has no elbow or knee joint; and it is also lacking any sort of central joint. This model is very clumsy and would most certainly not do.

Number vi is the same except for the novel wrist/ankle joint arrangement, there being two such joints, followed by two feet or hands. This model would also be very weak and clumsy.

Number v has a small double elbow or knee joint. This is still too weak and clumsy. Number iv, with one large elbow or knee joint, is no improvement.

These models, iv to vii inclusive, would have the same muscle fit as the models seen in Figure 3. All of them would be far too weak, and they could never meet all of the requirements of life. Number iii, likewise, would be, overall, too weak a model for every walk of life.

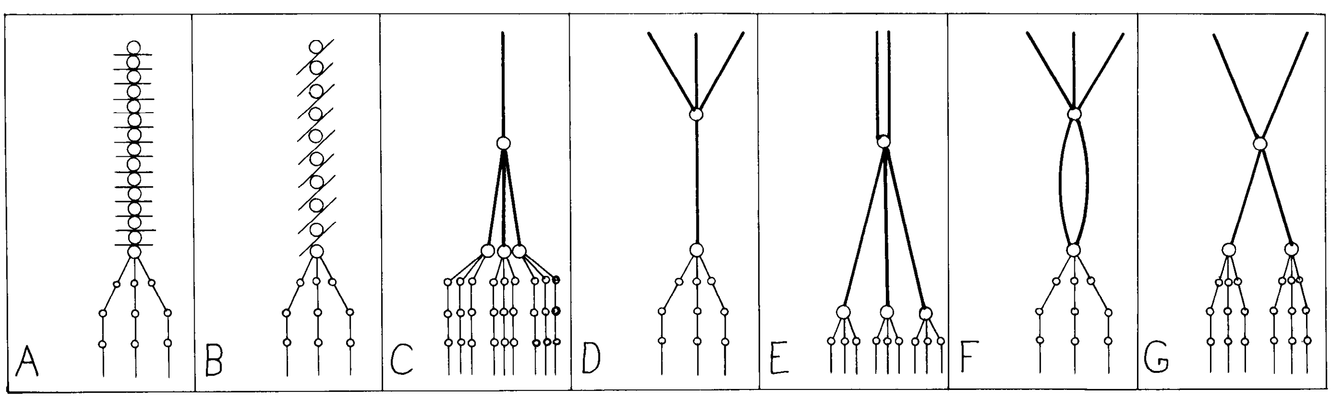

Figure 5. Some more hypothetical limbs. It is plain that these, too, are unsuitable.

Numbers i and ii would seem to be the most viable. It will be noticed that they come close to conforming to the pentadactyl plan. Number i is similar to X and Z, while number ii looks like X; and it would be even more so if there were one elbow or knee joint instead of two. The pentadactyl plan still outclasses Model ii as it stands; and the same goes for model i. And it is only in so far as i and ii resemble the present pentadactyl system that they come close to being viable basic plans.

Finally, we move on to Figure 5.

Here, model A consists of short long bones with joints. The musculature problems in this model are far greater than for those in Figure 3. This model, then, is useless.

Model B differs in having the short long bones set at an angle. This model is too weak and clumsy. Model C consists of long bones and has three feet on one leg (or three hands on one arm). It is clearly impractical, and would never suit all the walks of life.

Model D has three long bones on the hip or shoulder and one on the arm or leg. This model would be overall too weighty on top for one arm or leg bone to take. All existing limbs have one upper (arm or leg) bone, with two below, so that the animal can cope with the overall weight.

Model E has two bones at the top and three below, with three feet or hands. This model would not cope with all the many different modes of life.

Model F is perhaps the most viable of those in Figure 5, having three bones at the top and two at the bottom. There might, however, be too much weight at the top of the structure. There is one hand or foot at the bottom. Even this model would not be suitable for every mode of life. To adapt it to the mode of flying, i.e. to have a wing, many bones would have to go, while others would need modification. These changes, as might be expected, would lead us once more toward the present pentadactyl system.

Model G, like many others, becomes more and more outlandish, and would never do a satisfactory job.

In summary, then, permutations on long bones have been seen in Figures 3, 4, and 5. Permutations on short long bones on one side and short long bones with joints on the other have been seen in Figure 3. And permutations with numbers of long bones at the top and bottom,with several feet or hands on them, have been seen in Figures 4 and 5. This seems to cover the range of conceivable arrangements fairly well. The pentadactyl plan, without doubt, comes out on top.

Could the plan vary if need be? The answer is — possibly; but only within the limits of the plan. Indeed, it is difficult to imagine any variation which would be better than the present pentadactyl plan, in coping with the various environmental niches.

The Bird's Wing

The bird's wing is perhaps the most specialized case of the pentadactyl limb; and one might wonder whether a completely different arrangement might have been advantageous here.

For instance, why should there not be digits protruding from the wing, instead of being internal? An evolutionist might hold that the reptilian ancestors did once have such digits, but that they were lost to improve the efficiency of flight. But it could have been possible for every flying bird to possess such digits without impairing flight. Neither, had God chosen to create birds with such digits, would their flight necessarily have thereby been impaired.

Again, why have bones at all in the wing? Could they be replaced by a structure of strong muscle?

The smaller, active birds, e.g. swallows, snipe, etc., have solid bones. It might be possible to replace these with muscle, etc., of about the same weight; so such a thing might work. Even for these birds, though, the bulk of muscle necessary might lead to increased weight, reducing the ability to fly or even preventing flight entirely.

Larger birds have hollow bones, with a high ratio of strength to weight, to permit flight. If these bones were replaced by muscle (which would surely need to be solid) over the relatively large area of wing, it seems likely that flight would be impossible.

Conclusions

We have seen that there are already variations on the existing pentadactyl plan of limb. However, variations which get away from the pentadactyl arrangement would not work, for the various reasons which have been given.

The hypothetical designs which come closest to being viable are precisely those which are most like the existing plan. If the limbs were to depart far from the existing plan, other bones in the body, such as the flat bones which make up the ribs, would have to be rearranged and restructured. Even then, if the result were to be of any service, the arrangement would have to come close to the existing plan.

All animals with boned limbs will have one basic design for foot or hand, viz., digit(s) connected to a jointed ankle or wrist, the rest of the limb being suited to this arrangement. This, one may be sure, will be the pentadactyl plan.

Therefore, Creationists can answer in some detail questions about the pentadactyl limb, as used throughout the vertebrate animals. It is indeed a plan created by God.

Appendix: About Stance

Someone may now say: ". . . fair enough; I can see your point that the plan of the limbs is the best that there is; but what about the stance of some animals, e.g. many reptiles and amphibians? Is this not a bad design, having the limbs outstretched, instead of having them positioned under the body, as in mammals?"

The answer, I believe, to this question is *no;* it is not a bad design for such organisms. In considering the creation of such an animal as a typical reptile or amphibian, it must be remembered that the animal is cold-blooded. Its mode of locomotion, then, would have to be of such a design as not to outstrip its temperature-control system. If one were to give a typical reptile the limbs of a swift-running mammal, problems would set in. Such a limb and stance might very well cost the organism its life; for overall it would take too much energy to use such a limb. The animal in question may very well have a tendency to overtax its own physical resources.

There is another point. Many reptiles and amphibians live in muddy places, or half in water and half out. It may be that in such a situation, to glide along on the mud, in a way which is half walking and half swimming, is the most efficient way of moving about. And for such a way of moving, the outstretched limbs seem ideal.

So it is still true that the best possible boned limb is the pentadactyl design. Variations within that plan, including various stances, are very well designed for the animals which possess them, and for their particular niches.

Incidentally, reconstructions of the oldest crocodiles known, from the remains, seem to show that they had what some would call a better stance, i.e. a more mammal-like one, than do modern crocodiles. (Although the stance was not by any means that of a mammal.)

This may serve as another example of variation on a theme. Also, the following consideration arises. If a mammal-like stance were truly better, crocodiles must have degenerated over their generations, becoming less fit, contrary to Darwinian theory. No, the stance of modern reptiles and amphibians is well suited to their mode of life, and to the niche which they occupy. As for the ancient ones, I suggest that we know too little in detail about the niche which they occupied to say dogmatically what stance would have been best for them.

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THE VERTICAL TEMPERATURE STRUCTURE OF THE PRE-FLOOD VAPOR CANOPY†

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In this article is described continued work on the possibility that a vapor canopy formerly surrounded the Earth, and on the conditions which would prevail in and under such a canopy. It is believed that it is shown that a canopy could indeed have existed; but more work is still needed on some aspects of the matter.

The early chapters of Genesis as well as other ancient writing testify to an ancient belief that the earth at one time was surrounded by a "water heaven."[1] It was this water heaven that supplied the source of the 40-day rainfall described in the book of Genesis. However, the physics of such a canopy presents rather immense problems for numerical modeling. While there have been some crude initial studies of this problem,[2] there have as yet been no attempts to model such a canopy in more rigorous ways for study by numerical simulation.

This paper presents a one-dimensional radiation transport model of a water vapor and air atmosphere with some preliminary results. The atmosphere under the canopy is assumed to be chemically the same as the present atmosphere. The canopy itself begins at an altitude of about 10 km and consists of 88% water vapor and 12% air. A Newton-Raphson iteration was employed for solving a coupled set of nonlinear radiation flux equations for the steady state vertical temperature structure.[3] Fifty spectral intervals are employed using published values for the mass absorption coefficients and other data for the absorbers H_2, CO_2, and O_3. The convective adjustment was not included, although this is a relatively simple addition;[4] neither was Rayleigh or Mie scatter modeled in a rigorous fashion.[5] A more serious limitation however, is the fact that lateral advective heat flow involved with global circulation was not included in the one-dimensional treatment and that oceanic coupling was only crudely approximated.

We assume a flood rainfall rate of 0.5 inches per hour. This implies that the ancient canopy contained 12.19 m of water (0.5 inches/hr × 24 hr × 40 days = 40 ft = 12.19 m). Thus, the surface pressure was 2.18 Atm.

The Canopy Temperature Profile

We first define a vertical coordinate system for the model calculations. In our model we divided the canopy atmosphere into 20 layers (Fig. 1).

In Fig. 1, P refers to the pressure, which for the canopy atmosphere varies from 2.18 atmospheres at the earth's surface to 0.05 (we defined 0.05 Atm as the "top" of the canopy); u refers to optical path or the product of the density and altitude; and z refers to altitude.

The solar input is denoted by Q. Here S_i refers to the Planck emission from the surface of the sun in spectral interval i; θ is the zenith angle; and f is the fraction of daytime. Q_i is then the solar flux at the top of the atmosphere in spectral interval i. D, the solar distance factor, is explained below.

The chemical composition of each layer is given in Table 1.

We wish to calculate the set of layer temperatures that will cause the sum of the upward and downward radiation fluxes at each boundary to vanish. This is to be understood as the radiative equilibrium profile of the vapor canopy. The basic equations for the fluxes at each boundary are given by:[6]

†This article is based, in part, on the revised edition of *The Waters Above*. Moody Press, Chicago, 1983.

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