Insect evolution: a major problem for Darwinism

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Insects provide a severe challenge for Darwinian evolution. In contrast with the vertebrate fossil record, for example, where only bones are available, evolutionary speculation can run wild, but the exquisite detail of fossil insects has produced virtual silence on this front. A review of the insect fossil record literature reveals a complete lack of evidence for the evolution of insects and other arthropods. This is true in spite of an abundance of fossil insects preserved in amber, coal, volcanic ash, tar, and other environments dating back to the Cambrian era. The evolution of insect flight, wing folding, compound eyes and metamorphosis in particular lack fossil evidence—and these have presented significant difficulties for Darwinism for over a century and a half. The major differences between ancient and modern insects are that ancient insects were either larger than those of today or they have become extinct.

The insect challenge

Insects provide a powerful testing ground for any theory of evolution because their tough external structures have been frequently preserved in exquisite detail in the fossil record. Most textbook arguments for evolution rely heavily on vertebrate bones but vertebrate bone fossils lack the soft tissues that contain the most important information on differences between kinds. Fragmentary fossils always provide fertile ground for evolutionary speculation, but the often-flawless detail of the insect fossils has brought all such speculation to virtual silence.

Darwinists rarely discuss insects as evidence of evolution, in spite of the fact that the Arthropoda (insects, crustaceans, myriapods and arachnids) must have been a major feature of the evolutionary landscape. Something like 80% of *all* animal species are insects, and the grand total of all insect species is currently estimated at over 5 million.[1,2] The leading contemporary reference on insects, a 770-page tome by professor R.F. Chapman,[3] never even mentions insect origins, and the *opus magnum* of the late evolutionary champion Professor Stephen Jay Gould avoids mentioning insects altogether.[4]

Insects are not just bothersome pests—they carry out so many critical tasks that 'Civilization could not survive without them'.[5] Two of these many tasks are the pollination of most of our food crops, and recycling of organic material. Insects currently consist of 33 orders, including one that has over 300,000 species.[6] Arthropods are the most successful animals on Earth, and their 'ways of life and ecological niches are almost incomprehensibly diverse'.[7,8] Furthermore, most have short lifecycles, and thus they reproduce more rapidly and more prolifically than vertebrates. Consequently, they 'should evolve faster than vertebrates', but they don't—'the fossil record indicates that insects have evolved more slowly than the vertebrates'.[9] A further problem for Darwinism is that very little evolution is seen in the 'extensive fossil record', not only of insects, but also (with few rare exceptions) *all* other invertebrates.[10,11]

Speculation and disagreements about insect evolution

In the early 1950s, Harvard entomologist Frank Carpenter estimated that around a half-million invertebrate fossil specimens were then stored in museums and university collections. These are believed to date back to 340 million years ago when the 'forest swarmed with insects, including dragonflies, beetles, and cockroaches'.[12] Since the 1950s, the number of fossil insects available to researchers has increased enormously, so that today an 'extensive fossil record' of insects exists.[13] The fossil record is so good that 'their diversity exceeds that of preserved vertebrate tetrapods through 91 percent of their evolutionary history'.[13]

These 'diverse, well-preserved' insect fossils have been summarized in 20 major monographic studies since the 1960s.[14] In spite of this abundant material, and the conclusion that forests swarmed with insects in ancient times, there is a complete absence of fossil evidence for insect evolution. The first 20 million years of insect evolution 'are shrouded in mystery'.[15] For this reason 'all of the evidence used in the study of phylogeny is circumstantial'.[16] As a result, the evolutionary relationships among the basic groups of arthropods are

> '… purely hypothetical. Unfortunately, knowledge of the fossil record is of little help, because each group is distinctly defined in the Cambrian strata, from which the oldest "good" fossils come. This, of course, means that the supposed common ancestor arose in Precambrian times.'[17]

Paleontologists have often found what they assume are the trails of ancient early insects tunnelling through primitive soil, yet 'no bodies' have ever been uncovered.[12] The lack of fossil evidence of insect evolution leaves the field wide open to speculation. As a result, the

> '… evolutionary relationships among the [arthropods] … are unclear, although there have been a number of opinions expressed. Some investigators

argue that the arthropods are a polyphyletic group and that many of their similarities have arisen as a result of convergent evolution. However, others see them as clearly monophyletic, having evolved from a common ancestor. All three subphyla are well represented in the Cambrian strata… .'[18]

The polyphyletic/monophyletic controversy is still very much alive today.[19] At least five major theories of the ancestry of insects exist, with one (or more) leading evolutionist arguing for each.[20] These include the speculation that the ancestor common to all insects was an annelid or annelid-like creature that looked something like a modern earthworm.

This conclusion is based, not on the fossil record or other empirical evidence, but on evaluations of living organisms and much guesswork—primarily the observation that insects have a long, segmented body that is superficially similar (if you ignore the legs, wings and mouthparts) to modern, segmented worms. Because worm-to-insect evolution requires both the addition of many new structures and the loss of numerous other structures, it would seem that abundant evidence of these many changes must exist in the fossil record, but this is not observed.

Class Insecta is also assumed by many authorities to have evolved from a myriapod (millipede) or some type of protomyriapod animal during the Devonian period, but even this conclusion about insect origins is controversial.[2] Others argue that insects 'descended directly from trilobites; others think the immediate ancestors were crustaceans'.[21] Yet others argue that 'insects evolved from centipedes in the Silurian'.[22]

And more study of a specific insect has not helped in revealing its evolutionary history. For example, although 'the Holometabola or endopterygotes are by far the most-studied insects, their origin is completely unknown'.[23]

Meglitsch and others have concluded that the segmented worms 'apparently evolved from the ancient protostomes, which also gave rise to the mollusks' and were the ancestors of insects.[24] But Labandeira discounts this view, and instead argues on the basis of biomolecular studies that insects and other hexapods evolved 'from an unspecified lineage of crustaceans'.[25] He admits that 'hexapod origins remains unsettled', and that morphological evaluations still favour a non-crustacean ancestor.[25] Recent studies have also looked at the role of regulatory genes such as Homeotic (Hox) genes in insect evolution.[26,27] This research, though, has shown only how mutation of Hox genes could cause the *loss* of structures in history so it adds little to the evolutionary argument.

Theories of insect evolution

Insects are arthropods and the same problem of lack of transitional forms also exists with this larger group. Gamlin and Vines note, under the subheading 'Evolution of the arthropods', that the arthropod fossil history dates back to

Some Darwinists propose that insects evolved from millipedes, while others argue for a centipede ancestor.

'… more than 600 million years, but, unfortunately, there are no fossils of their earliest ancestors. Because they share an exoskeleton and jointed limbs, biologists once assumed that all arthropods arose from the same stock. Yet *recent studies of living arthropods* suggest that there are three main lines which evolved independently: the Crustacea, the Uniramia and the Chelicerata' [emphasis mine].[28]

Romoser concludes that no consensus exists on the evolutionary relationships of insects and other arthropods. In his words, 'opinions vary' because the fossil record totally lacks transitional forms, and in almost all cases the fossil forms are virtually identical to modern forms**.**

Although the most common view is that insects evolved from some type of myriapod, Romoser and Stoffolano concluded it is more likely that myriapods and insects both evolved from some unknown common ancestor.[29] Other evolutionists argue that 'it is reasonable to suppose that' the earliest insects 'were similar to silverfish', an animal that appears in the fossil record an estimated 350 million years ago.[30] The lack of transitional forms is a major reason why phylogenetic trees vary so drastically.[31] Furthermore, the dominant view of insect evolution (from myriapods) is not supported by RNA analysis.[32]

The fossil evidence

Arthropod fossils date from the Cambrian era[33] but most fossils are 'too advanced to reveal clear relationships with other groups'. Gamlin and Vines claimed that worm-like onychophorans have provided some 'real evidence' of insect progenitors, but they also note some of the major problems in determining *any* progenitors for insect evolution:

'One major difference is that the limbs of crustaceans are branched (biramous) whereas those of insects and myriapods are always unbranched, even in their embryonic stages—hence their new name "Uniramia". Chelicerates also have unbranched limbs but they lack antennae and have a different set of mouthparts, in particular a pair of pincer-like structures called chelicerae. Finally there are fundamental differences between the groups in the way the legs and jaws move, which suggest that each developed limbs independently.

'Of the ancestors themselves, little is known, and only the worm-like onychophorans provide any real evidence. The construction of their body wall and excretory system is distinctly annelid-like, but they also have appendages that could have been the forerunners of the insects' segmented limbs, as well as insect-like antennae, and tracheae for breathing. All this suggests that the Uniramia evolved from annelid stock, but the ancestors of the other groups—the crustaceans and chelicerates—remain a complete mystery.'[28]

The problem is not lack of specimens. In one site in Colorado 'over 100,000 specimens have been collected ... some which are perfectly beautiful, almost as if they have been freshly mounted'.[34] The Florissant Colorado Shales alone have produced over 60,000 specimens.[35] The Burgess Shale in British Columbia, the Elmo Kansas Limestone, and the Hunsrück Shale in Germany are three other important sites. Many insects are extremely well preserved, even tiny ones such as mites,[36] and many 'exquisitely preserved insects' have even retained their 'external color patterns and internal gut contents'.[37] Many of the best fossils are preserved in amber (a tree sap that hardens to a golden yellow). Over 150,000 fossil insects have been collected from Baltic amber alone.[38] Amber is an excellent preservative, often retaining insect wing veins, mouth parts, facets of the compound eye, spines in the legs, and genitalia, in exquisite detail.

The great advantage of using insect fossils to test evolution is that most insects have exoskeletons, and consequently their external morphology is usually well preserved, whereas with most vertebrates, frequently only the internal skeleton (or more often, fragments only) is found. The fossil record so far has revealed only about 20,000 extinct insects,[2] and otherwise there is little evidence of change:

'… by and large the insect population of today remains remarkably similar to that of the earlier age. All the major orders of insects now living were represented in the ancient Oligocene forest. Some of the specific types have persisted throughout the 70 million years since then with little or no change… .'[39]

Buchsbaum *et al*., in their classic text on arthropods, liken insect evolution to a good novel that contains clues to the mystery as one reads until the 'earliest and most important events' are about to be revealed, and one then discovers

'… that the rest of the pages in the book are missing. Just this kind of exasperating situation confronts us when we try to relate different phyla of animals to one another in an orderly scheme. Anyone can see that honey bees are much like bumble bees, that bees resemble flies more than they do spiders, and that spiders are more like lobsters than like clams. But when we attempt to relate groups, especially phyla, which, by definition, are groups of animals with fundamentally different body plans, there is little we can say with certainty. The different groups of arthropods are clearly allied to each other as well as to annelids; but how arthropods are related to each other, or to such utterly different animals as sea stars or vertebrates, remains quite a mystery.'[40]

Change is indicated in the fossil record, but does it support Darwinism? Morris observed that extinct fossil insects are 'very similar to those living now', except that many ancient insects are 'much larger than their modern relatives'.[41] Examples include giant dragonflies (some, dated to the Jurassic, had wingspans as long as 30 inches, compared to 3 inches today), giant cockroaches, and giant ants. Although larger, 'their form is no different in essence from that of modern insects'.[41] Darwinists have concluded that most of these giant insects became extinct (or, more often, evolved into smaller-sized species) because their bodies were too large to hide effectively from predators. This contrasts with the alleged major trend of Darwinism to produce larger-sized animals, such as the horse and many chordates, including, especially, primates. Darwinists also postulate that large insects originally evolved their large sizes to better compete with other insects. Both conclusions are logical but contradictory, and lack empirical evidence.

The variety of both extant and extinct insects is enormous—fully 34 fundamental mouth-part classes have been identified in extant insects, and two in extinct insects.[42] The major innovations in insect evolution, compared with their supposed ancestors, include the evolution of wings and flight, the evolution of the compound eye, and metamorphosis.

Evolution of the insect wing

The insect wing is a complex, well-designed structure[43] and the insect's ability to fly is a mystery that is only now being unravelled.[44] Made out of an extremely light, but amazingly strong, tough material called cutin, wings are reinforced by a complex set of various veins that provide structural support where needed, yet resist bending and twisting to supply the needed strength.[45,46] The 30-odd wing muscles housed in the thorax are the most powerful muscles known per square millimetre of cross-sectional area. Although 200 times per second is typical in some insects, they can beat as fast as 1,000 times per second.[47] The wings can also be opened up to absorb heat, like solar panels.

The origin of the insect wing and insect flight is 'one of the most controversial topics in paleoentomology'.[48] The lack of fossil (or other) evidence has thus resulted in enormous speculation.

> 'No structure in the Arthropoda, an extensive group of animals, has given rise to such a variety of hypotheses about their origin as have insect wings. Interest in the more than 150-year-old theories of insect flight has not faded ... .'[15]

Ancient insect fossils 'had fully developed wings', and no evidence of partly developed wings has ever been uncovered, even though insect wings 'are usually well preserved' in the fossil record.[49] Because bird wing bones are homologous to animal limbs, it was long assumed that bird wings evolved from limbs.[50] Insect wings, though, are not modified legs, but structures additional to the legs.[51] The problem of wing evolution is commonly dealt with by assuming that insects 'borrowed' other organs to achieve flight—a process called co-option. The problem in determining what organs could be co-opted for wing use is no easy matter.

The evolution of insect wings is considered a 'momentous event' in evolution because, aside from bird wings, insect wings are 'the only true wings in the animal world'.[52] They are also momentous because 'so miraculous a thing is insect flight that nearly all insect biologists believe it could have evolved only once'.[53] Insects are also the 'only group of invertebrates that includes members capable of active flight'.[17] All Pterygota (winged insects) have two pairs of wings—one pair on mesothoracic body segments, and one pair on metathoracic body segments.[54] Although speculation abounds, and many theories have been postulated, Labaneira notes that only two now remain, and these both face numerous problems. The first, called the *paranotal theory*.

> 'It proposes that wings originated from rigid, lateral projections of thoracic terga that became enlarged, flattened, supplied with a regularized system of veins, and eventually articulated with the thorax to produce flapping flight. However, the paranotal theory suffers from several deficits, including absence of evidence for an articulatory wing hinge characterizing the attachment of paranotal lobes to an associated thorax, thus disallowing flapping flight.'[48]

Insect wings are complex, well-designed structures, and their origin is one of the most controversial topics in paleoentomology.

The second theory, called the *epicoxal theory*, speculates that

> '… serially homologous protowings originated in semiaquatic insects from small appendages located above the leg bases, known as epicoxal exites, initially for purposes other than aerial flight. Subsequently protowings developed laterally on thoracic and abdominal segments from these exites, which were initially articulated to the pleurae, a condition different from the initially rigid attachment proposed by the paranotal theory.'[48]

Although this theory is more consistent with the embryological, genetic and fossil evidence, 'Nevertheless, an intermediate stage by which gills or other homologous lateral structures could have been converted to functional aerial wings has always been challenging.'[48] As Marden admits, 'Until someone presents direct fossil evidence of the earliest winged insects, there will be room for new viewpoints, interpretations and lively debate.'[55]

Carroll concludes that what we find in the fossil record does not support 'the nearly continuous spectrum of evolutionary change postulated by Darwin'. In fact, the 'almost incomprehensible number of species' that inhabit Earth today 'do not form a continuous spectrum' but instead

> '… nearly all species can be recognized as belonging to a relatively limited number of clearly distinct major groups, with very few illustrating intermediate structures or ways of life. All of us can immediately recognize animals as being birds, turtles, insects, or jellyfish, and plants as conifers, ferns, or orchids. Even with millions of living species, there are only a very few that do not fit into readily recognizable taxonomic categories. … Even among the hundreds of thousands of recognized insect species, nearly all can be placed in one or another of the approximately thirty well-characterized orders.
>
> '… Fossils [should] be expected to show a continuous progression of slightly different forms linking all species and all major groups with one another in a nearly unbroken spectrum. In fact, most well-preserved fossils are as readily classified in a relatively small number of major groups as are living species.'[56]

Another problem is that insect wings do not function independently, but must articulate appropriately with the body, and must also function as a unit, which requires coordination by a nervous system of great complexity. The energy needed for flight is also enormous—as much as 100 times that needed for resting.[57]

Evolution of the folding wing

With very few exceptions (such as dragonflies), all winged insects have a 'complicated system of joints' that allows them to fold their wings compactly over their abdomen.[58] Not a simple structure, the folding wing is, in the words of a University of Chicago neuroethologist, 'the most morphologically complex joint in the animal kingdom'.[59] A variety of folding systems exists, including longitudinal and transverse, all requiring unique muscle and nerve designs.[60] Yet no evidence for the evolution of wing folding has ever been found in the enormous insect fossil record. The fossil record shows that folding wings have always existed in insects—from the earliest forms found until those of today—and that no evidence exists to indicate that folding wings evolved from non-folding wings as assumed by Darwinists. For example, cockroaches have folding wings, while dragonflies do not, and both made their debut contemporaneously in the fossil record.[61,62]

The evolution of the insect compound eye

Another major event that must be explained is the evolution of the insect eye. It is a complex structure called a 'compound eye' consisting of a large number of closely packed visual elements, each one of which contains its own separate lens. Many insects, including the fly and honeybee, have about 4,000 'eye' units in each of their two compound eyes. All terrestrial vertebrates have simple eyes, while most sighted insects have complex, compound eyes called *ommatidia*. The fossil record indicates that the very first insects had compound eyes every bit as complex as those today.

Even extinct animals with compound eyes, such as trilobites, also had perfectly developed eyes. Many insects (and spiders also) have two or three spot-like eyes called *ocelli*. Still another common insect eye type called the *stemmatta* is found on the heads of larvae. The compound eye can detect the sky's plane of polarization, an ability that helps an insect to navigate. Compound eyes are also very sensitive to movement, and are especially well designed for insect flight.[63,64]

Honeybees have 4,000 eye units in each of their two compound eyes.

Evolution of insect metamorphosis

Metamorphosis, the division of insect life into two distinct stages such as illustrated by a caterpillar and butterfly, is another area where evidence is lacking in the fossil record to support evolution. Fly larvae look nothing like flies, and major differences in *internal* anatomy also exist. Many insects undergo complete metamorphosis involving the larva, pupa, and adult stages. Complete metamorphosis is found early in the fossil record, and no evidence of its evolution has ever been found. In fact 'If an entomologist were transported by time machine back to the Jurassic period he would feel right at home among the insects on the earth.'[65]

This problem is so difficult that few Darwinists have ever even attempted to speculate on how insect metamorphosis could have evolved. Some entomologists have concluded that, in the field of insect evolution, metamorphism is the most difficult evolutionary advance to explain.

Insect evolution as told in the textbooks and popular literature

The popular literature and textbooks often ignore the topic of it,[66] or present a very different picture of insect evolution than that documented in the professional literature reviewed above. Many popular articles and books imply that insect evolution is well documented, and tell elaborate 'just so' stories about how such evolution occurred, as is obvious from the following example:

> 'The ancestors of the insects (and of other arthropods) probably resembled the marine worms of today. Their bodies were composed of many identical segments. In the insects, the segments gradually changed and fused into three distinct body parts, each of which does a particular job. ...The marine worms had spread-out nerves; nerves in the insects are bunched together into three centers, each serving its own body part.
>
> 'The ancestral worms had a pair of legs on each body segment. Slowly, of course, insects developed joints in their legs and rigged them into every sort of appendage a mad inventor could dream up. At the front, they were reshaped into biting and sucking parts as various as the curlable sipping straw of the butterfly, the toothy pincers (called mandibles) of the beetle, and the poison squirter of the soldier termite.
>
> 'Those at the rear became the egg-laying ovipositors of grasshoppers and the stingers of bees.

Metamorphosis, the division of insect life into two distinct stages such as the caterpillar and butterfly, is such a problem to Darwinists that few have attempted to speculate how it evolved.

> 'Even the three limb pairs in the thorax that are used for walking didn't remain primitive.'[67]

Although this reference implies that the story it presents is based on evidence and has been proven, it is actually pure speculation. Nonetheless, the story does illustrate that the changes required for worm-to-insect evolution are enormous, requiring a major redesign of the worm. The article continues, noting that insect appendages are

> '… delicate and very long in the mosquito, come equipped with an elastic spring in the leaping flea, have pouches for carrying pollen in bumblebees, are tipped with suction cups in houseflies, and are bent into fearsomely toothy claws in the preying mantis.
>
> 'That's an example of how ingenious evolution is. New body parts are made by revamping old ones, so that whether what sticks out from an insect walks, bites, or lays an egg, it is only a newfangled leg.'[68]

Although no empirical evidence exists for any of this speculation, one never would learn this from reading the chapter.

Conclusion

Over one million species of living insects have now been identified. If all 33 orders had evolved from a common non-insect ancestor, then a large number of transitional forms must have existed. Yet the abundant fossil record indicates a complete lack of such evidence for insect evolution. It now appears likely that the expected transitional forms have not been found because they never existed. Insect kinds all appear in the fossil record fully formed, and all such examples either remain today or have become extinct. A summary of the fossils by one of the leading researchers concluded that:

> 'Insects, which can be traced to the Devonian, have constantly remained numerous and varied. Like the Crustacea, some of their orders and superfamilies have indeed become extinct; however, their antiquity notwithstanding, they have always remained unchanged during the course of their history; they retain as many types as in the past.'[69]

In particular, we lack credible evidence for the evolutionary origin of the many complex structures that are unique to insects, such as their compound eyes, flight structures, wings that fold, and the amazing metamorphosis system that causes development from a worm-like young into a totally different adult form.

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