Cave men - Systematic zoology began with the cavemen [although even before man evolved, animals probably distinguished between different types of animals - good vs. bad]. When man began to communicate (speech, writing), he would use certain words to refer to the kinds of organisms about him, often being quite descriminating in his distinctions. For example, many primitive peoples of today are very knowledgeable about the faunal components of their environment - in fact, often times they are more so than professional zoologists. [A tribe in the mountains of New Guinea was found to have 137 specific names for 138 species of birds. Only one species was confused with another (Mayr, et al. 1953:5).

Ancient Greeks - Our records of formal classification of animals date from the period of the Ancient Greeks. Plato, Aesops, and others, for example, mentioned various animals, including insects, in many of their works. But it was Aristotle who first brought together the knowledge of his time and formulated it into the beginnings of a science. Although he did not develop a formal classification, he provided a basis for such a classification in his statement that "animals may be characterized according to their way of living, their actions, their habits, and their bodily parts." He refered to such major groups of animals as birds, fishes, whales, and insects, and utilizing certain terms for lesser groups, such as Coleoptera (beetles) and Diptera (flies), which persist today.

Plato and Aristotle were members of the **teleological school** (Plato was the founder). The Principle of teleology is that nature does nothing in vain. Every morphological peculiarity had a purpose. Aristotle's endeavors to find a purpose in all events often led him astray. Aristotle described about 500 animals and some with varieties - or about 600 species. His **"Entoma"** was the first deductively derived classification for the insects. **Entoma** - are bloodless animals that have more than 4 feet and some have wings. They are neither bony or fleshy. Their body is rigid within and without. His classification was first based on whether the insect had wings or not and then secondly on the mouthparts:

I. Winged
  1. with elytra
  2. without elytra
    a. with 4 wings
    b. with 2 wings

II. Wingless

I. Having teeth and being omnivorous

II. Being without teeth, but having a proboscis
  1. feeding on all saps - flies
  2. feeding on blood only - mosquitoes
  3. feeding on sweet saps only - bees

With few modifications, Aristotle's concepts served the students of animals for nearly 2000 years.

Middle Ages - During the middle ages, especially the 1100's, books called **bestiaries** flourished. A bestiary was a serious work on natural history, but was more of a compilation of different writings (sort of a naturalist's scrapbook). These often had no single author, and often expanded everytime it was copied. A predominant idea of the time was that of **spontaneous generation**.

Aldrovandi (1522-1605) - in 1602, he published the big folio-volume *De Animalibus Insectis libri VII* which was the first work of literature in the world dealing with insects. This established entomology, and especially systematic entomology as a science. In his classification of insects, his first separation was between land and water insects. Further breakdowns were based on wing and leg morphology.

Swammerdam (1637-1685) - Dutchman who in 1669 published a classification of insects based on metamorphosis: 1) insects without metamorphosis; 2) insects with metamorphosis in which wings develop gradually; 3) metamorphosis with a pupal stage; and 4) metamorphosis within the original larval skin.

Vallisnieri (1661-1730) - in 1713 he published a classification of insects based upon where it resided: 1) insects in plants; 2) insects in water; 3) insects in earth or land substance; and 3) insects in other animals or insects.

John Ray (1628-1705) - Of all the early authors, he is the one who had the greatest influence on Linnaeus. He improved upon Swammerdam's classification, basing his classification on morphological and biological

fact, which caused him to develop a more natural higher classification than did those who had preceded him. He clearly recognized the difference between the species and genus concepts for which he gave definitions:

> species concept: "offspring from the same parents or identical parents."
> genus concept: "groups of species which resemble each other."

Pre-Linnaean names - Although the species and genus concepts originated before Linnaeus began his work, they were not used in a consistent fashion. For example, if there was only one species in a genus, it was called by its generic name [*Musca*]. When 2 species were known another word was added to separate the 2 [*Musca canum* and *Musca carnivora*]. If more were known more words were added to distinguish them, until in some cases an organism's name would actually consist of a short description. This was because they tried to use the name for 2 functions: naming and describing. The specific name, whose function was diagnostic evolved into a specific phrase which had to be elaborated and changed each time a new species was added to the genus. The need arose for a simple "label."

Carolus Linnaeus (1707-1778) - in 1758, he published the 10th edition of his *Systema Naturae*. This date and this publication has been adopted as the starting point in nomenclature because it was the first work in which the binomial system of nomenclature was consistently applied to animal species. This has resulted in the nearly universal abandonment of all pre-1758 literature for taxonomic or scientific purposes [exception is Clerck's 1757 *Svenska Spindlar*]. Even though names coined prior to Linnaeus were still used Linnaeus is still given credit for them (Aristotle's names Coleoptera and Diptera are now attributed to Linnaeus, 1758). The binomial system separated the name of a species from its description. He also established the concept of hierarchial classification.

This publication gained widespread approval and adoption for several reasons. First, as already mentioned it was the first to consistently use binomial nomenclature and was able to bring some order to the chaos at the time. Secondly, Linnaeus was well known and had quite a reputation - he was much respected. Thirdly, he used very precise, good species descriptions. And finally, he wrote in latin, the language of all educated persons of that time. His system was not completely original, but it was very practical.

Linnaeus utilized the following categories: class, order, genus, species, and sometimes variety. He used the form of the wings as his primary character to establish his insect orders. In the original edition (1735) he recognized 4 orders: Coleoptera, Angioptera (= Hymenoptera), Hemiptera, and Aptera. His insects included all arthropods, but not worms. By the 1746 edition he recognized 7 orders. By the 12th edition (1767) he had divided the Aptera into sections we now recognize as myriapods (centipedes and millipedes), crustaceans, and arachnids.

Linnaeus had several major opponents of his system. One, a German named Klein, wanted to use only external characters for classifying animals. He was opposed to using teeth of animals because it was too dangerous to open their mouths. Another was Buffon, who thought the system would be too constraining to accurately represent nature.

Fabricius (1745-1808) - He was a pupil of Linnaeus and was much influenced by Linnaeus. He has been called the foremost entomologist of the 18th century. He described over 10,000 species of insects (Linnaeus had 2000), and many new genera. He used mouthparts as his primary character to separate his orders. He used different names for his orders: Eleutherata (= Coleoptera), Rhyngota (= Hemiptera), Piezata (= Hymenoptera), Antliata (= Diptera), and Glossata (= Lepidoptera). In addition, he made other "classes": Ulonata (= Orthoptera), Synistata (= Neuroptera) and Odonata (the only order name of Fabrcius' to still be in use).

Latreille (1762-1833) - He was a good friend of Linnaeus. He combined the best of the classifications of Linnaeus and Fabricius to form a more natural classification. He introduced the concept of the family taxa. [Note

Haeckel (1886) added the category phylum - so kingdom, phylum, class, order, family, genus, and species are considered to be the **obligate categories**].

Scientists renamed the organisms described in polynomials or vernacular. After 1800, virtually all authors had adopted the Linnaean system of naming. A new source of confusion arose as many authors decided to change names if they were incorrectly formed according to Greek or Latin grammar or appeared to be inapplicable (e.g. *brunneus* was changed to *viridis* if the animal was found to be green in nature). Geographical names were changed if they were found to be inaccurate. The need developed for a set of rules of nomenclature. Linnaeus had a set of rules, Fabricius had one for insects, and there was one for parasites. The situation was bad, especially in Europe due to the Napoleonic wars which caused a drastic reduction in the distribution of scientific publications. If you went from England to France, you could recognize the bugs, but not the names attached to them, and the same thing happened if you went to Germany or Russia. A series of codes of zoological nomenclature were developed. There were several national codes as well as some for special groups such as birds. Eventually it became evident that zoological nomenclature was an international matter and the International Rules of Zoological Nomenclature was adopted in 1901 and has been in effect, with revisions, ever since. (Mayer et al, 1953:203-212)