possess appendages modified for attachment, and sometimes retain a free habit of life as distinguished from the parasitic females. See Arachnida.

Among Insects the sexes are distinguished by varying modifica­tions of different parts of the body, and differences in general form and in colour are frequent. The males are generally active and more beautiful, and seem better endowed with sense organs, though usually smaller than the females. The males have also a pre­eminence or even monopoly in producing sounds, and it is perhaps in relation to this that the psychology of sex can first be said to come within the range of observation. Thus the field-cricket is said to lower the tone of his song while caressing the female with his antennæ. In the parasitic forms dimorphism, as might be expected, becomes very marked ; in *Strepsiptera* the males are free and winged, while the females are blind and wingless, in fact, permanently larval. Similar cases occur in other orders, the glow­worm being probably the most familiar instance. In parasitic or abundantly nourished forms parthenogenesis very frequently appears, the extreme case being presented by *Cecidomyia,* a fly which exhibits rapid parthenogenetic reproduction in the larval state. The dimorphism of many beetles, in which the male frequently acquires the most extraordinary specializations of external form, has received especial attention from Darwin, whose *Descent of Man* includes the fullest details. Here it is enough to mention that Reichenau has recently pointed out the coexistence of the larger size and relative inactivity of the male with the presence of these functionless outgrowths. The beautiful sexual dimorphism so common among the Lepidoptera need not be more than mentioned at present ; while the very remarkable sexual differentiation of *Hymenoptera* (bees, ants, sawflies, &c.) may also be assumed to be sufficiently familiar. See Insects, Ants, Bees. In several orders *(Diρtera, Lepidoptera, Coleoptera)* cases of dimor­phism occur among the females themselves, or even among the males ; as many as three forms of females have been described in certain butterflies.

The Molluscan series opens with the normally dioecious Lamelli- branchs, of which some genera (most species of *Ostrea, Peeten,* &c. ) are, however, hermaphrodite. The Pteropods, Pulmonates, and Opisthobranchs are hermaphrodite ; the Prosobranchs, Heteropods, and Cephalopods unisexual. Though slight differences have been described even in Lamellibranch shells (*Unio*), and though the internal anatomy of the essential and accessory organs is of very high complexity, the extraordinary phenomena associated with “ hectocotylization ” among the Cephalopod are the only marked outward manifestations of that sexual dimorphism which reaches its climax in the Argonaut. (See Mollusca, Cuttle-fish.) The Tunicates are usually hermaphrodite; *Amphioxus,* however, is unisexual (see Tunicata).

Among Fishes hermaphroditism is extremely rare *(Serranus).* The males are sometimes characterized by the modification of the pelvic limbs as claspers, &c., and are at the reproductive period often readily distinguishable from the females by their brighter colour or other cutaneous changes, such as ruffling of the skin. Male and female rays are readily also distinguishable by their teeth and dermal defences. The hooked jaw of the male salmon gives him a characteristic physiognomy during the breeding season. The carp undergoes a sort of epidermic eruption at the same period ; male and female eels, too, are said often to become distinguishable both in colour and shape. Stridulating apparatus may be present, notably in the Siluroids. (See Ichthyology.) Among Amphi­bians the bright dorsal crest of the male newt is perhaps the most striking of sex distinctions, but many male frogs and toads have vocal air sacs, epidermal callosities, and some *(Cultripes, Pelobates)* possess a gland under the fore-limb. (See Amphibia.)

Among the Ophidians the males are smaller, and have longer and more slender tails ; the sexes, too, differ sometimes in colour and markings. Male Chelonians, too, have sometimes longer tails and claws and may even give voice. The submaxillary musk-gland of the crocodile is especially active in the breeding season ; the lizards have remarkable throat-pouches and crests, which may be epidermic or even correspond to cranial outgrowths, as in the chameleon.

But it is among Birds and Mammals that the observer of sexual characters finds abundant and remarkable differences extending to the minutest details, and showing how the higher evolution of parental care which the inevitably prolonged embryonic life in­volves and the wider range of sexual selection have co-operated in modifying the whole organism. As might be expected, the lower mammals show least of this ; but as we ascend the adult males become differentiated from the females by the acquirement of secondary sexual characters which are mainly either offensive and defensive aids for battle with each other, or which assist in gaining the admiration of the females ; and these may coexist or coincide in very various degrees. Thus scent-glands are of common occurrence from the *Insectivora* (perhaps even from *Ornithorhynchus)* upwards. Greater beauty of markings or more vivid colours are acquired,— in many *Anthropidæ* (baboons, &c.) the latter being of peculiarly

crude magnificence. Abundant local growths of hair often appear, most notably in the lion and in many *Anthropidæ.* The develop­ment of tusks and horns is also too familiar to need more than passing mention.

But it is unquestionable that in this as in not a few other respects the birds, rather than the mammals, have reached the highest stages of evolution. For here sexual characters no longer seem merely superadded or supplementary to the apparatus of individual life, but habits and organization alike become thor­oughly adapted to these—the sex-differences and the reproductive functions as it were saturating the whole life, and producing so many and marvellous results, in habits and character, in beauty and song, that it is not to be wondered at that the descriptive labours of the professed ornithologist have constantly risen into those of the artist and even the poet. See Birds, and Darwin’s *Descent of Man.*

*Nature and Determination of Sex.—*It is not here pro­posed to enter upon the task of historical review and criticism of the various theories of sex—which were esti­mated at so many as five hundred at the beginning of the last century, or even to attempt any sketch of the present very conflicting state of opinion on the subject. @@1

Although our theories of sex may be still vague enough, the greatest step to the solution has been made in the general abandonment by scientific men of the doubtless still popular explanation—in terms of a “natural tend­ency ” for the production of an excess of males or the like. It is now held that “ quality and quantity of food, elevation of abode, conditions of temperature, relative age of parents, their mode of life, habits, rank, &c,, are all factors which have to be considered.” The idea that the problem of the nature of sex is capable of being approached by empirical observation of the numbers of different sexes produced under known sets of conditions, and the obvious practical corollary of this, viz., that the proportion of the sexes must therefore be capable of being experimentally modified and regulated, are conceptions which have steadily been acquir­ing prominence, especially of late. In short, if we can find how sex is determined, we shall have gone far to investigate sex itself.

One of the most crude attempts has been that of Canestrini, who ascribes the determination of sex to the number of sperms entering the ovum, but this view has been already demolished by Fol and Pflüger. The time of fertilization has also and apparently with greater weight been insisted upon ; thus Thury, followed by Düsing, holds that the sex of the offspring depends on the period of fer­tilization : an ovum fertilized soon after liberation produces a female, while the fertilization of an older ovum produces a male. This view has been carried a step farther by Hensen, who suggests that the same should probably hold true of the spermatozoa, and thus the fertilization of a young ovum by a fresh sperm would have a double likelihood of result­ing in a female. There are some observations which support this : thus Thury and other cattle-breeders have claimed to determine the sex of cattle on this principle, and Girou long ago alleged that female flowers, fertilized as soon as they are able to receive pollen, produced a distinct excess of female offspring.

Great weight has also been laid on the relative age of the parents. Thus Hofacker, so long ago as 1828, and Sadler a couple of years later, independently published a body of statistics (each of about 2000 births) in favour of the generalization (since known as Hofacker’s and Sadler’s law) that when the male parent is the elder the offspring are preponderatingly male : while, if the parents be of the same age, or *a fortiori* if the male parent be younger,

@@@1 As for reproduction in general, so for sex, the most convenient starting-point is the work of Hensen (“Die Zeugung,” in Hermann s *Hdb. d. Physiologie),* while other dissertations are to be found in the leading manuals of zoology and botany, especially, however, in special papers too numerous to mention. See also Reproduction, and for fuller bibliographical details see Geddes, " On the Theory of Growth, Reproduction, Sex, and Heredity,” *Proc. Roy. Soc. Bdin.,* 1886.