A Note on Sexual Dimorphism and Sexual Selection

"With animals having separated sexes there will in most cases be a struggle between the males for possession of the females. The most vigorous individuals, or those which have most successfully struggled with their conditions of life, will generally leave most progeny. But success will often depend on having special weapons or means of defense, or on the charms of the males; and the slightest advantage will lead to vistory."

This evidently impeccable summary statement comes from p. 468 of the Facsimile Editio of Darwin's On the Origin of Species, First Edition. He also has statements on pp. 87 and 156-157. Everywhere Darwin mentioned sexual selection in his 1859 book he also said something like "But I have not space here to enter on this subject." Of course he finally got around to it in 1871 with his two volumes on The descent of man and selection in relation to sex. London: John Murray; 2nd ed. 1922, NY: Appleton. Notice the three categories of selection by which Darwin would account for sexual differences: (1) selection favoring, "the most vigorous individuals," (2) selection favoring those with "special weapons," and (3) selection with regard to "the charms of the males." The last two categories will involve secondary sexual characters, and the third involves what is commonly called "sexual selection." Many biologists, including A. R. Wallace in particular in Darwin's time, have rejected the third. But see how R. A. Fisher in The Genetical Theory of Natural Selection, considers Darwin' ideas, in particular the last two (pp. 146, 147, 151-152.).:

"The theory put forward by Darwin to account for the evolution of secondary sexual characters involves two rather distinct principles. In one group of cases, common among mammals, the males, especially when polygamous, do battle for the possession of the females. . . . For the second class of cases, for which the amazing development of the plumage in male pheasants may be taken as typical, Darwin put forward the bold hypothesis that these extraordinary developments are due to the cumulative action of sexual preference exerted by the females at the time of mating."

"Certain especially remarkable consequences do follow if some sexual preferences of this kind, determined, for example, by plumage characters, are developed in a species in which the preferences of one sex, in particular the female, have a great influence on the number of offspring left by individual males. In such cases the modification of the plumage character of the cock proceeds under two selective influences (i) an initial advantage not due to sexual preference, which advantage may be quite inconsiderable in magnitude, and (ii) an additional advantage conferred by female preference, which will be proportional to the intensity of this preference. The intensity of preference will itself be increased by selection so long as the sons of hens exercising the preference most decidedly have any advantage over the sons of other hens, whether this be due to the first or the second case. The importance of this situation lies in the fact that the further development of the plumage character will still proceed, by reason of the advantage gained in sexual selection, even after it has passed the point in development at which its advantage in Natural Selection has ceased. The selective agencies other than sexual preference may be opposed to further development, and yet the further development will proceed, so long as the disadvantage is more than counterbalanced by the advantage in sexual selection. Moreover, as long as there is a net advantage in favour of further plumage development, there will also be a net advantage in favour of giving to it a more decided preference."

Those of you who are intrigued by this topic and enjoy analyzing mathematical arguments may be interested in seeing if O'Donald (1962) cited by Williams (1966) really is formally analyzing the last part of Fisher's argument. You might like to

consider what kind of female, born into the hopelessly polygynous Yanomamo society described below by MacCluer, et al (1971: J. Phys. Anthrop.) will maximize her reproduction:

"Yanomamo males whose fathers are powerful (and therefore polygynous are more likely to obtain extra wives (and children) themselves, with the result that a few men have many more grandchildren than the average, i.e., there are large groups of individuals who are related to each other as first cousins. Among 61 men in the four villages who were born before 1909, there are four who have 41, 42, 46, and 62 grandchildren, respectively. Moreover, two of the men are fathers of the other two. For comparisons, no female born before 1909 has more than 31 grandchildren. . . Thus, there is a sort of inheritance of fertility which can have important biological implications, especially in view of the fact that it is among the most powerful males in the population that polygyny is most common . . . ."

On p. 166, Trivers restates Fisher's argument, but a little differently:

"The effects of female choice will depend on the way females choose. If some females exercise a preference for one type of male (genotype) while others mate at random, then other things being equal, selection will rapidly favor the preferred male type and the females with the preference (O'Donald, 1962). If each female has a specific image of the male with whom she prefers to mate and if there is a decreasing probability of a female mating with a male as a function of his increasing deviation from her preferred image, then it is trivial to show that selection will favor distributions of female preferences and male attributes that coincide. Female choice can generate continuous male change only if females choose by a relative rather than an absolute criteri n. This is, if there is a tendency for females to sample the male distribution and to prefer one extreme (for example, the more brightly colored males), then selection will move the male distribution toward the favored extreme. After a one generation lag, the distribution of female preferences will also move toward a greater percentage of females with extreme desires, because the granddaughters of females preferring the favored extreme will be more numerous than the granddaughters of females favoring other male attributes. Until countervailing selection intervenes, this female preference will, as first pointed out by Fisher (1958), move both male attributes and female preferences with increasing rapidity in the same direction. The female preference is capable of overcoming some countervailing selection on the male's ability to survive to reproduce, if the increased reproductive success of the favored males when mature offsets their chances of surviving to reproduce."

through sons

why won't the daughters why will the granddaughters

because sons of females mating w/ extreme males will be more numerous) so if tendency to favor extremes is inherited in females through sons...

"Natural selection will always favor female ability to discriminate male sexual competence, and the safest way to do this is to take the extreme of a sample, which would lead to runaway selection for male display." (p. 167)

Perhaps you can use these arguments to develop a reasonable hypothesis to explain the absence of mimicry in butterfly males in species such as Papilio dardanus in which the females are mimics even of several different models.

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[Transcription:]
First note: Why won't the daughters? Why *will* the granddaughters?
Second note: because sons of females mating with extreme males will be more numerous; so if tendency to favor extremes is inherited in females through sons...