Fifteen Years of Snakeskin Topsword Guppies in the UK

(Revised with improved photographs)

.....by Alan Charlton.....

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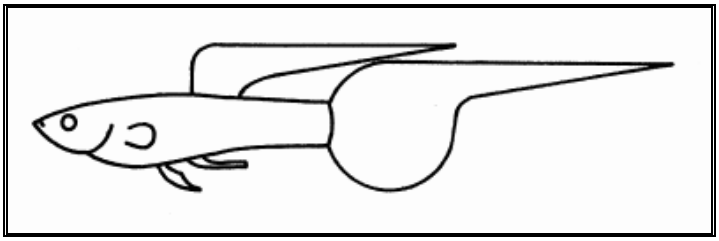

Topsword Standard Outline
(Fancy Guppy Association 1973)

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Over 15 years from 1967 to about 1982 I bred a continuously changing line of snakeskin (or cobra if you prefer the American usage) topsword guppies to the Fancy Guppy Association's standard. They won awards at some major guppy shows over the period. I wrote a brief history of the line for the Fancy Guppy Association Journal in 1976. After that there were further adventurous inputs into the line, but no account was written. But I had the records, and some photographs..... I was prompted to write this extended and more rambling version by the growth of the World Wide Web, believe it or not. On the one hand I could find on the Web active guppy sites around the world, though sadly nothing much in the UK - on the other hand, I realised I could put my ramblings into the Web, with pictures, and someone might get some use, interest, or even inspiration out of them. In 2002 web articles with quantities of good photographs retrieved very slowly so I used quite small photographs. Since then the internet has speeded up a lot, and also my ability to reproduce good photographs has improved. Be warned, I have let myself ramble off in different directions at times, so in addition to patience, a reader will need some very basic knowledge of genetics.

The line was allowed to die out about 1982 or so. By this time the fancy Guppy Association was on its last legs and there was no viable guppy-breeding society in the UK. There seemed little point in continuing to breed specialised show guppies. It seemed a pity to let the line die out, but I consoled myself with the thought that I had passed breeding stock on to others many times, and there was a chance that some enthusiast might keep the line going. As I write I have no idea whether this happened. When I first saw a green snakeskin topsword guppy in 1966, at the Fancy Guppy Association's International Show in Manchester, the type had already had at least 15 years of development. The first recognisable snakeskin guppies seem to have been the Lacetail or Leopard strain of the famous W.G.Phillips of the FGBS, which emerged some time in the 1950's or earlier, and are pictured in Myron Gordon's book "Guppies as Pets", published in 1955 by TFH. Grey or blond in basic body colour, these fish had

the greenish snakeskin body markings, usually coarser and less extensive than later versions, and they had short clear dorsal fins, wild-type caudal fins with some patterning and a tendency to an upper extension. I had some fish of this type in 1958, from the famous (or infamous, depending on one's view) C.R. Perry in Crewe. He claimed they were from Phillips' original stock and I am sure this was correct. Exhibition fish they were not.

Lacetail guppies (photo Mervin F. Roberts. Reprinted with permission from Guppies as Pets, TFH Publications, Neptune City, NJ.)

While Perry had the original Phillips form in the 1950's, there were already guppies around with much more elaborate snakeskin markings on body and fins, and some sword extension. Eduard Schmidt's article in Tropical Fish Hobbyist (July 1964) on the origin of the half-black guppy, shows a recognisable snakeskin topsword with good markings on body and caudal fin, a clear dorsal and a fairly well-developed sword.

Early snakeskin topsword (photo Eduard Schmidt. Reprinted with permission from Tropical Fish Hobbyist magazine, July 1964, TFH Publications, Neptune City NJ.)

In the TFH article, Schmidt claimed the half-black body feature arose in 1956 as a mutation in fish of Phillips' strain which had been kept in Germany for many generations. The mutation was X-linked, according to his description. Since the snakeskin gene Fil was Y-linked (see next paragraph) it seems likely that the half-black mutation had nothing to do with the actual snakeskin genes - it could have happened in any other strain (and probably did). Out there - someone may have reconstructed the history of the half-black and its subsequent variations.
As a byway - I haven't tried to keep up with technical publications on guppy genetics much. Back in my guppy-breeding days there wasn't a lot to know that was relevant to "fancy" guppies. Basic body colours like blond (usually wrongly called gold), gold-lace, albino, were known to be determined by autosomal recessive genes, the grey wild-type was dominant. Half-black was normally an X-linked dominant, but wasn't a

basic body colour, it was really a colour pattern gene. The well-known geneticist Winge, working at the Carlsberg Foundation in Denmark, had shown that a number of shape and colour pattern characters in males were sex-linked, and that some colour pattern features were autosomal. In 1951 Hildemann, who later became an eminent immunologist, wrote a Master's thesis in which he showed some swordtail features were autosomally inherited, rather than sex-linked, and involved more than one gene. This work was never formally published and this may have been because Hildemann did not investigate whether his findings applied to guppies with the known genes in Winge's strains (which could well have been available at that time). Dzwillo, in a classic paper published in 1959, had actually investigated some later cultivated strains than Winge's, including Vienna Green doubleswords, snakeskin swordtails, and an early broadtail (facher) strain. He showed, for instance, that bottomsword and some other short-tail guppies had an X chromosome that was basically shape-neutral, which he called X Ch. Females with two X Ch were clear-finned. Vienna green doubleswords had Y-linked swordtail and body pattern genes and and there was an X-linked factor which intensified the sword appearance. If short-tail guppies like Vienna Green were crossed with the broadtail, the first generation offspring always had broadtail character, and he concluded that a dominant X-linked gene Cp was responsible for the basic broadtail features. He used the German name "filigran", i.e. filigree for the snakeskin feature, identified the gene for filigree as Fil, and showed it was Y-located. Dzwillo's fish had well-developed snakeskin pattern in body and fins, and some sword-like extensions. Dzwillo did not seem to consider the Vienna Green body pattern as being the same thing as filigree, i.e. snakeskin. Generally no distinction has been made between the two body patterns, but I have always thought of them as genetically different - has anyone ever seen a Vienna Green topsword?
Coming back to 1966 and the green snakeskin topsword at the FGA International - by the standards of the fish that were bred later, the fins were well-coloured but rather short.I think this fish was bred in the UK, as there were very few overseas entries. I thought I might like to breed guppies like that! Then in 1967 one of our local fish outlets had some snakeskin topswords on sale, not a pretty lot, with clear dorsal fins and untidy small lower swords as well as the upper extension. They were throw-outs from a local breeder, but I never found out who this was. Anyway, we bought one for 2 shillings - 10 pence today! It should have been 2 shillings and 6 pence - half a crown - but we didn't have the exact change and the dealer was in a good mood.

Just like the original snakeskin topsword, but 3 generations on (31)

At this stage I had some red-tailed grey-bodied topswords which had been bred from some of C.R. Perry's mixed-up left-over guppies, and decided that it would be interesting to see if the red could be combined with the snakeskin.

Red topsword of the line used here

I knew the red topsword feature was X-linked but didn't know about the snakeskin. When the cross was made, using our bought male, to my surprise I instantly had snakeskin topswords with lilac-coloured bodies, pinkish dorsals, and red tails. It soon became apparent that the snakeskin topsword feature was Y-linked (I only found out about Dzwillo later).

Red-tail snakeskin topsword (14)

Then the red colour was improved by crossing in a different X-linked red, which also introduced an X-linked factor for vertical bars on the rear body, presumably Winge's tigrinus gene. The red also showed up in the females' caudals.

Red-tail snakeskin topsword with barred pattern (25)

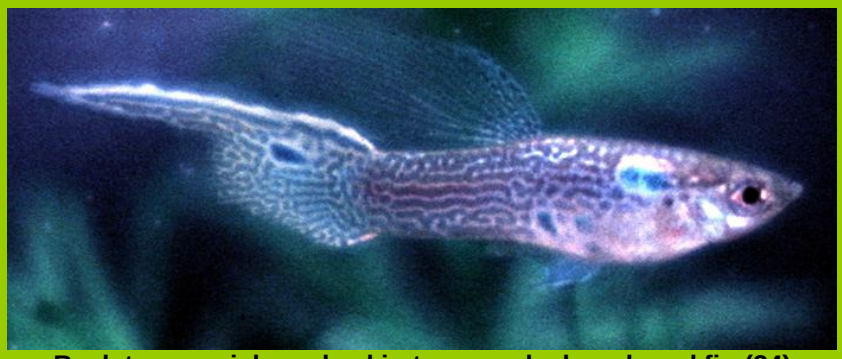
Red topsword female, same brood (25)

This X-linked red topsword was quite adaptable - when a green bottomsword was mated with these females quite nice doubleswords resulted

Doublesword by combination (37)

The red-tailed snakeskin topswords looked good on the show bench, but they didn't photograph well. The colour films of the time did not do justice to the more subtle red tones in guppies! Anyway, fish from the line produced a second place in the topsword class at the 1969 FGA International Show and won the class at the 1970 International. But the line was in a bad way by then, as it had been difficult to fix the caudal shape and this involved backcrossing to the stage of grandfather to granddaughter. Too much inbreeding! the colour was getting paler and the males were fully developed at 5 months, early for swordtails, and didn't live much longer than that. An new approach was needed.

So, back at the ranch, in another set of snakeskin topswords the red topsword X linked factor was eliminated by another cycle of inbreeding and also an outcross to a common guppy with a coloured tail. This common guppy must have been carrying an X chromosome of the clear-fin variety, because half the male offspring were greenish snakeskin topswords without a trace of red. There must also have been blond in there. In the new lineage that resulted, there were grey and blond-bodied versions of the original snakeskin topsword type, but now we were back to the uncoloured clear dorsals, tendency to lower extensions on the caudal, and the body had a definite lilac cast rather than the desired green. In breeding this lineage it was easy to select females that weren't carrying red, as they had completely clear fins.



Back to greenish snakeskin topsword, clear dorsal fin (24)

Clear-finned topsword female not carrying red (24)

The tigrinus bars had vanished with the red. This branch of the line was given an outcross to Vienna Green doublesword (from Malcolm Delingpole of the Birmingham group) but it was never a great success on the show bench, as it still had the clear dorsal and rather poor caudal, and a rather unpleasing yellow cast to the colour.

Vienna Green doublesword used in outcross, father of 47

Young snakeskin topsword (51) Grand-dad was the Vienna Green doublesword above

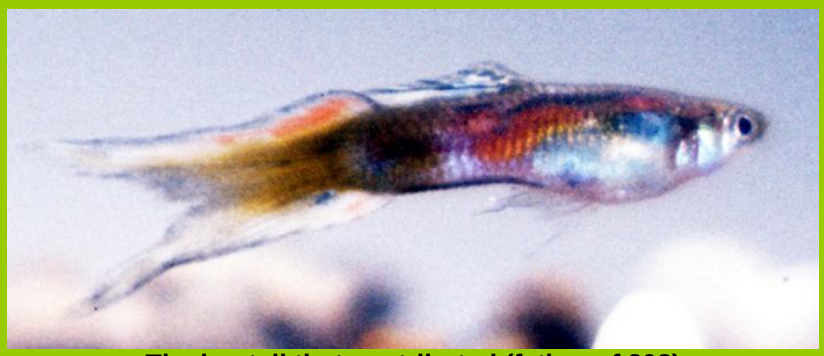
But luck saved the day again. This time, it was a couple of outcrosses. The first was in the shape of progeny of a clear-finned grey female from a local store - these were mostly very poor broadtails, but somehow one of the females of the batch got accidentally bred with one of the last branch of the real topsword strain in late 1971. To my surprise some quite good green snake topsword males appeared, and now they had coloured dorsal fins, plus also vertical bars had appeared on the body again. The other outcross appears complicated now, but it was just breeding by "following one's nose". It used a half-black topsword found in a store, and a blond delta, both bred with females from the red snakeskin topswords, and crossing the resulting hybrids. Although I had been concentrating on the red-tailed topswords, I hadn't eliminated the uncoloured X chromosome in this complex. Consequently the second outcross "mess" produced a brood in which about half the females showed red in the tail, half didn't. So it was possible to eliminate the red entirely at this point by crossing a green snakeskin male from the first outcross to clear females without red from the second messy outcross. In carrying out these outcrosses, at the time I "just did it" without too much deep thought, and only worked out in detail later what had been done (what records can do for you). But here I was with a revitalised line of topswords, with new colour in the dorsal fins.

Snakeskin topsword now with colour in dorsal (164)

The half-black topsword was a fun diversion. Breeding him with a female from the topsword line showed that the half-black was X-linked and the Y carried a sort of snakeskin topsword, but rough compared to the established form. Inbreeding the F1 produced half-blacks with a mixture of topswords and doubleswords (plus more snakeskin types of course). Although I tried for a while, I could never get consistent sword shape on these fish. I gave some away, and the recipients managed to breed from them half-blacks without any swords at all.

Half-black swordtails (53)

At around this time I wrote a short article on swordtail genetics for the FGA Journal, in which I indicated the swordtail characters I had been using were sex-linked. Dr. Larr in California picked this up, claimed on the basis of Hildemann's 1951 thesis work that swordtail characters were autosomally determined, and soon we were embroiled in a controversy which eventually fizzled out without a conclusion - I think mainly because the only way of sending text articles around then was snail mail. I never understood why Dr. Larr took no account of Winge's extensive work. The only reason I could think of then was that both Hildemann and Larr had connections with the University of Southern California and there was strong institutional loyalty! Since the time when this article was first written, the growth of on-line library resources and general information have added more information. Hildemann died tragically early in 1983, Larr in 2006, so they can't add anything directly. But it turns out that Hildemann's later published work in 1954 accepted Winge's main demonstration of sex-linked swordtail characters and also the existence of some autosomally linked characters. Dr. Larr seems to have taken a very blinkered view. He also turned out to be a mystery. Hildemann's degrees and career are easy to trace, but I can't find "Dr." Larr ever getting such a degree. He seems to have been involved in geology and optics, and must have done well in these as he retired early and well-off in 1966 at about 40 years of age. He was later one of the prime movers in a rather eccentric "Chapel of Awareness" in California. His associates at this time seemed to think he had several degrees..... one attributes to him Ph.D's in Stratigraphic Micropaleontology and Religious Science, and Masters Degrees in Astronomy, Biology and Geology! Anyway, the newly coloured line was nearly wiped out before it got going, as an infestation of Camallanus worms ruined most of my stocks in 1972. But some topswords survived, and some progeny of an experimental cross of a poor lyretail into the topswords. Out of these arose a new line, in both grey and blond forms.



The lyretail that contributed (father of 208)

I wouldn't have used the lyretail crosses for anything normally, they were just made out of curiosity, but the stock situation was quite desperate after the losses. The grey topswords bred from these survivors were quite good though more lilac than green. The blond topswords were not much good, they were pale in colour and their swords were short. One of the grey males won the topsword class in the 1973 FGA International Show. Another male was given to Peigi Young for an outcross to her strain of snakeskin topswords (that was probably descended from the same stock as my original male). The progeny of this outcross did very well for Peigi - a set of males won the topsword class at the OGG's 1973 Vienna International Show, and another male won the topsword class at the 1974 FGA International Show. I wondered what became of the fish that went to Vienna, as I don't remember any snakeskin topswords coming back from Austria in the next few years.

One of Peigi Young's topswords

While Peigi Young's topswords were doing well, my line was going under again. Colour was getting pale, fin extensions were short. It was looking as though the line needed another outcross. I had actually started an outcross, but what I got was less of an outcross, more of a mess! I usually had some broadtail guppies around, and in early 1972 had bred a red-tailed grey-bodied snakeskin broadtail with a red-tailed blond female, both imported Singapore fish.

Blond female that turned out to carry albino, mother of 222

This cross produced grey, blond, and albino offspring, the first time I had had albino guppies. They were "broadtails" but the shapes were disgusting!

Grey-bodied male from the brood that included albinos (222)

Albino from the same brood - not wishing to be photographed! (222)

Anyway, I thought albino snakeskin topswords would be nice. So I had crossed the topswords through the albinos. As the other line declined I persevered with the albino crosses. It was one of the worst projects in my guppy breeding! Between 1972 and 1975 I think I only produced 2 or 3 reasonable albino topswords - the other fish had trouble with short swords, forked swords or bent bodies, and there was poor fertility. Yet there was good to come out of this mess - the blond factor that had come from the cross was definitely an improvement over previous versions of blond, and would prove its worth later.

One of the few decent albino males (259)

Female from the same set, caudal colour from the broadtail input (259)

At this stage the albino complex of course had blond in there, and so did the older line of topswords that it was crossed into. A blond male from the albino complex was mated to a blond female from the older line, and this produced a nice line of blond topswords, darker than the previous versions. The first generation or two showed great hybrid vigour, they were a good size and long-lived. One male was first put on the show bench at the 1974 FGA International, won Best Livebearer at the 1974 British Aquarists Festival, and then won Best Male at the 1975 FGA International. He died at 2½ years old!

Blond snakeskin topsword from this stage of breeding (259)

Blond snakeskin topsword shown at BAF 1974 (326)

The same topsword at 2¼ years old (326)

Later generations of this line were not as good. I had handed some of it over to a serious breeder in South Wales and it was doing well for them, so I dropped it myself. Anyway I had another major outcross in progress then - another attempt at albino topswords - so space was a problem. At the time I dropped the blond topswords they were doing a trick which has often been a pain with the blond version. Males would develop in a promising manner, they got quite large, but they never developed much sword extension and the colour was pale.

The next attempt at the albino topsword started in earnest in 1974 but the story really started in 1970 when Midge Hill sent over from California to the FGA International some nice red-tailed albino deltas. I acquired some guppies derived from this stock in 1973, but this was not a simple story! Another guppy breeder had got some of the red-tailed albinos..... had bred two red-tailed albino broadtails together and got grey-bodied offspring! He was amazed, and gave some of these to me to see if I could make sense of them. When they were bred full sib, the offspring included grey, blond, and two forms of albino, one with pink eyes and one with much darker ruby eyes. Yes, there seemed to be two different genetic versions of albino.

Two albino fry from the same brood, ruby-eyed Type A at top and pink-eyed Type B at bottom

At this stage I got in touch with Midge Hill, and found that she had been working on the genetics of albino guppies. She had found two genetically distinct types of albino in American guppies, which she called Type A and Type B, and a third type in guppies from Singapore, which she called Type C. The red deltas, she said, were Type B but could also be carrying Type A. At the time I understood this work was about ready to write up, but I'm not aware that it actually was. Anyway, it looked as though I had the genes for all three types present in my 20 tanks now. As a test I bred an albino from my Singapore-derived stock with one of the females from the albino-derived greys I'd been given. These grey females must have been heterozygous for two different albino genes already, Type A and Type B, and so mating them with an albino of the Singapore version would produce no albino offspring in the F1 if the Singapore gene was a third one, i.e. Type C. No albinos resulted..... yes, I had all three albino genes now.

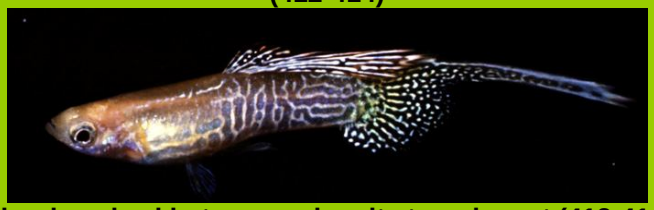
As a digression, albinism results from an inherited inability to produce the black pigment melanin. In humans there are some forms in which the conversion of tyrosine to melanin is blocked, and other forms where tyrosine production is reduced but the enzyme tyrosinase is present which normally converts tyrosine into melanin. There was a simple test for which version of albinism a person had - pull out some hairs, leave the basal bulb in a tyrosine solution for a while. If the base turned brown or black, these were tyrosinase-positive albinos, if not, tyrosinase-deficient. I am not aware that anyone ever looked at albino guppies in this light, but I did notice that when Type A and Type C albino fry were born to grey-bodied females they had quite dark red eyes, darker than you got in albino-born fry, while the Type B had pink eyes whatever. I suspect the Type B was tyrosinase-deficient, and the others tyrosinase-positive. A lot of albino mammals have eye defects, including aberrant neural connections and a pronounced squint. I don't know how you would detect a squinting guppy! However, I also noticed that the Type A and Type C broadtail guppies were not as good as the Type B. This seemed to be due to a minor difference in swim-bladder formation, so the bladder did not extend as far back in the A and C as it did in the B or grey guppies, and consequently the A's and C's were tail-heavy.

I decided to breed the Type B albino version of the topswords from this stock…... here we go

Red delta Type B albino mated with clear-finned topsword female (parents of 353)

Given that the programme would involve fish carrying B and probably A on one side, and C on the other, I would generate strains which would continue to carry the A and C which I didn't want, as well as the B that I did want. But at least fish homozygous for Type B would always be recognisable by their pink eyes at birth. There was no problem in getting albino topswords of type B albino - I had early on crossed a red-tailed albino delta with a clear-finned female from the topswords. Now the topsword line and the albinos both had blond in there, and so when the cross with albinos was bred on to produce topswords there were albinos, grey-bodied fish and blonds. The grey-bodied males were either green or lilac in colour. Not only that, but the shape of the fish came good in the broods born in autumn 1975. The females were nice too, and fertility was good. This was an overload of possibilities!

Three snakeskin topswords, two grey-bodied and one Type B albino, all from closely related broods. One of the greys has a green body, one lilac (412-414)



Blond snakeskin topsword, quite translucent (412-414)

Type B albino snakeskin topsword (412-414)

Blond snakeskin topsword with albino female (412-414)

Gravid female Type B albino with fry protection (413)

By using a diversity of colours in subsequent matings I managed to keep all the colours going until I ceased serious guppy breeding. The males were good on the show bench while there were still FGA shows to go to - and eight of the blond version went to the Austrian International Guppy Show in 1979, won first and second in the blond swordtail class. As these were all heterozygous for Type B albino they may have given someone a pleasant surprise later. The stock was passed on to a number of

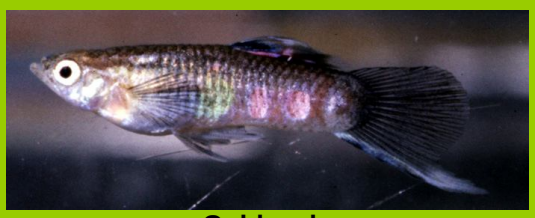
people in the late 1970's, and there is a nice photograph of an albino from some stock that went to South Wales, on the cover of the September 1976 PetFish Monthly.

There was a lot of "unfinished business" that I would have liked to follow up. The first blond versions always had short fin extensions in comparison with greys. Over the years the fin extensions on caudal and dorsal got longer in general, but in the later stages the blond were usually as long as the greys. I believe the improvements were due to genes introduced from the broadtails that were crossed in. In fact the total input into the continuous descent of the topswords over the whole period was:

Males
Broadtail 4; topsword 2; doublesword 1; short-tail 2

Females
Broadtail 3; common guppies 1; short-tail 1

It would have been interesting to produce the topswords in the basic body colour known as gold or gold-laced (and not to be confused with blond, though that is often erroneously called gold). In this the body is quite yellow but the scales are edged with black



Gold male

Also in the line of "unfinished business" was an investigation of crossing-over. Every so often a snakeskin-less male or two would turn up in a brood of snakeskins, and these males had clear tails with no sword extensions. Had the snakeskin/topsword gene complex been lost from their Y chromosomes by crossing-over to the X?

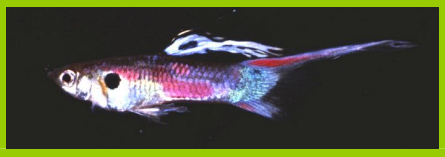
Male without snakeskin or topsword - a cross-over (396)

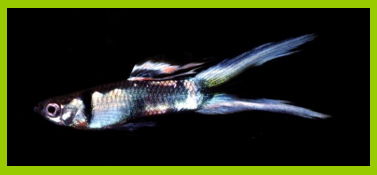
Less obvious, but they did occur, were females with a faint spotting and iridescence in otherwise clear caudal fins. These could have been carrying crossed-over snakeskin/topsword on a X chromosome. I set up crosses once or twice to see if the cross-over idea was right, but I never carried them right through as I always ran out of tank space.

Occasionally the snakeskin pattern and shape combination partly broke down, but I never tried anything with these fish.


Snakeskin breakdowns

Snakeskin doubleswords turned up too but I deliberately avoided mixing these with the topswords. The small acquaintance I had with them suggested this was a Y-linked feature. The occasional other topswords and doubleswords that appeared in tanks of mixed guppies were also tempting - here are four……



In 1934 Winge had shown that it was possible to shift sex determination in guppies on to autosomes, and to have the sex chromosomes behave like autosomes. This also would have been rewarding to play with, considering that so many colour and shape features in guppies were determined by genes on the sex chromosomes in the normal situation.

From some time in the 1970's I would sometimes breed bought broadtail males to females from the swordtails..... it was perfectly possible to reassemble broadtails from these crosses, and sometimes they were good. I reckoned that I had put enough of the general genetic background of broadtails into the snakeskin topswords to allow this to work. These crosses were only for entertainment and/or outcrosses for the swordtails. It was also particularly interesting to cross snakeskin broadtail males with the shape-neutral females of the topswords - the results in the first generation were snakeskin swordtail males with broad fuzzy swords.

Progeny of snakeskin broadtail x clear-finned topsword (424

But there was a type of broadtail I did want to breed if I could get the genetic components. I wanted to breed broadtails with the Y-linked body pattern of a Vienna green, and a multicolour spotted delta caudal. I believe this caudal type is known as "Variegated" now, and I knew back then that it was X-linked. So, as breeding of show guppies was declining in the UK, I managed to lay my hands on the components of what I wanted to try to breed, and embarked on some serious broadtail breeding. I crossed a male with a nice big spotted caudal with a topsword female, and then bred two more broadtails to the offspring of this cross.

Spotty-caudal male that was used - poor picture!

One version, an established line, had males with the Vienna Green body pattern and a mostly green caudal, and gratifyingly the first hybrid offspring had the desired colour combination. Further inbreeding and backcrossing resulted in some very nice deltas, and they came with the Vienna green body pattern and two versions of caudal - one variegated, one multicolour, mostly green with some red etc. I always regret not photographing these, but my guppy-breeding was definitely winding down at this stage in 1979. Although I don't have any photographs, I do have the show cards that these fish were awarded in the German Guppy Federation International Show in 1979 - first and second in the filigree/cobra/snakeskin delta class. Maybe someone out there has photographs of the fish? If so I'd like to see them.

The other male I put into the broadtails was a red-tailed "normal" snakeskin delta, and his progeny also came out quite good broadtails. I crossed the variegated side of the experiment back to this set to eliminate the "normal" snakeskin, and then I was going to run two parallel lines with the Vienna Green body pattern, one with variegated tails and one with multicolour. I got as far as this in 1980 before giving up on serious record-keeping. The broadtail experiment also carried blond, albino, and the X chromosome of the topswords, I bred topswords from the established line to them, to give the topsword line an outcross. Again, this was as far as record-keeping went. The topswords were kept going from this outcross until I stopped keeping guppies around 1982.

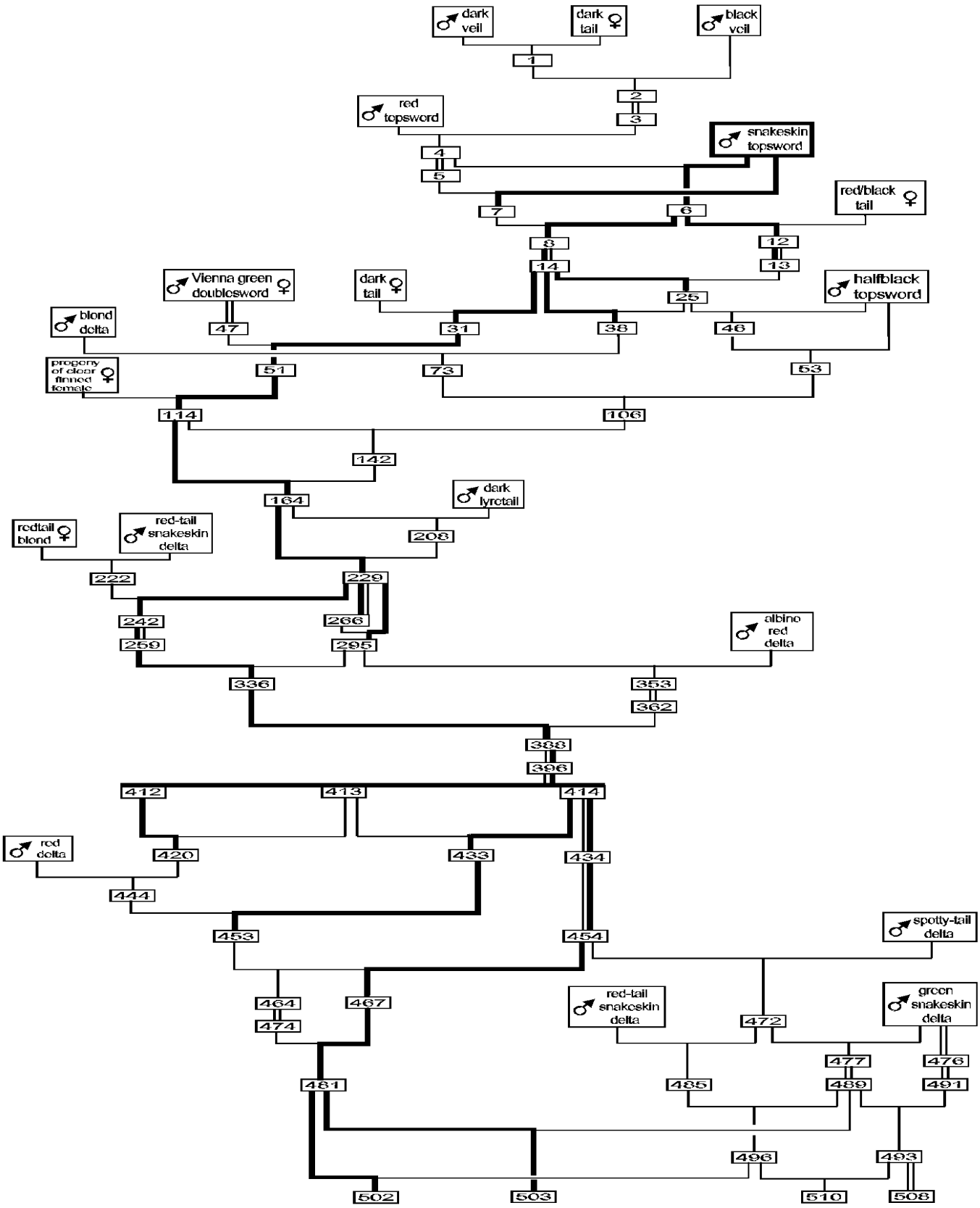
When I began to write this stuff I drew out the family tree of the swordtails, something I had done only as far as early 1970. It's reproduced at the end of the artcle. It was extensive, to say the least! and so it got reduced to the bones, i.e. only the continuous line of descent from start of guppy breeding to the end of the records. One very curious fact emerged from this tree. Until I worked it through I had thought that I had eliminated all but one X chromosome from the topswords at the generation after the

point where the coloured dorsal fin came in, that all the fish were carrying the new X that got in at mating 114. Tracking through - no, mating 164 used fish from 114 and also 142. Now the female that I used from 142 was carrying two X chromosomes from the previous stage of the line. So from mating 164 there were two different X chromosomes from quite different sources, and nothing that I did subsequently would have guaranteed that I eliminated one of these!

Anyone interested in large-scale long-term production of guppies of a particular strain will probably feel that the tale of the topswords is a prime example of "How Not To Do It". For them, yes, that's true. If you're a small-scale hobbyist, I'd recommend my way. It was never boring, you usually had some diversity of shapes and colours. The line did well in guppy shows over many years, yet it was run in parallel with other fishkeeping for a lot of the time, and I only had a maximum number of 20 aquaria, 16 of 18x10x10 inches and 4 of 36x15x15 inches. The diversity of types of guppy that had an input into it seemed to give it a sort of tolerance or adaptability. I believe that the use of so much broadtail material as an outcross for the swords themselves for a long time had made it completely feasible to use the line as an outcross for broadtails. In fact it had some advantages here as, if you crossed a broadtail male into it, you could always keep track of the particular X chromosome that male had contributed. While if you cross broadtail to broadtail it is often difficult subsequently to know which X is where. The last rounds of breeding showed all these things. The topswords and broadtails were intimately related, and both kinds were highly successful on the show bench.

by Alan Charlton

The chart of descent is reproduced on the next page


dark veil
dark tail
black veil
1
2
3
red topsword
snakeskin topsword
4
5
7
6
red/black tail
8
12
13
14
25
Vienna green doublesword
dark tail
halfblack topsword
blond delta
47
31
38
46
progeny of clear finned female
51
73
53
114
106
142
164
dark lyretail
redtail blond
red-tail snakeskin delta
208
222
229
242
266
albino red delta
259
295
336
353
362
388
396
412
413
414
red delta
420
433
434
444
453
454
spotty-tail delta
464
467
red-tail snakeskin delta
472
green snakeskin delta
474
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