SOME REMARKS ON THE GENUS CHIROCENTRUS (CUV.)

by

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Most recent authors agree, that the genus *Chirocentrus* consists of one species only, i.e. *Chirocentrus dorab* FORSK. BLEEKER, however, in 1852, created a second species, *Chirocentrus hypselosoma*. In his "Atlas Ichthyologique" T.6 he maintains the two species, but all later authors have, as far as I know, combined them to one again, which, of course got the older name *Chirocentrus dorab*.

Now Prof. Dr. H. C. DELSMAN, while studying the planctonic fish eggs of the seas of the Indo-Australian Archipelago, found quite regularly two different eggs, both belonging to *Chirocentrus*. They were, at first sight already, so entirely different from each other, that the question forced itself upon us whether BLEEKER was not right after all with his two species.

At Dr. DELSMAN's request I have made a special study of this problem. It proved at first to be no easy matter to distinguish more than one species or race. Gradually, however, I succeeded in finding a few differences. These differences were slight ones, but they proved to be constant, and I think they afford sufficient reason, in combination with Dr. DELSMAN's results, to reestablish the two species of BLEEKER, as will be pointed out below.

Both species of *Chirocentrus* are long slender fishes of pelagic habits, which are named by the natives Parang-Parang or Golok-Golok (sword). They are said to attain a length of more than one metre, but specimens of more than 90 cm are very rare on the fishmarkets. (STEAD in his "Fishes of Australia" gives a length of more than 4 metres, which, as pointed out by Dr. DELSMAN, must be an erroneous statement).

They are voracious fishes with a good number of strong canine-like teeth in the jaws. The praemaxillary bone bears two very strong conical teeth pointing horizontally forward. These two teeth are covered by an upperlip which is automatically withdrawn when the mouth is opened. At the same time the two teeth separate from each other. The fore-end of the maxillary bears some little teeth which are followed behind by a few big ones. Towards the back part of the jaw they become more slender and gradually diminish in size. The mandibulary bone bears 5 - 10 strong teeth, of which the third or fourth is always extraordinarily strong.

In the mouth we see a patch of little teeth on the palatines, the tongue is

teethless. The gill arches and copulae are wholly covered by small but strong teeth.

Young specimens possess more teeth than old ones which is especially the case with the teeth in the mandibulary.

The intestines are, in agreement with the carnivorous habits, very short. The stomach is a big blind sack with longitudinal folds in young specimens and irregular low ridges in older ones. It is as long as the whole abdomen and may often contain two or more undamaged fishes. I have found in the stomach of a specimen of 65 cm (without tail) a *Chirocentrus* of 24 cm that had been swallowed whole. The intestine itself is short and straight from the gullet to the anus. It contains a rudimentary spiral valve, as was noted by CUVIER. There are no pyloric appendages.

The fishes are mature, when they have reached a length of about 40 - 60 cm. In one individual of 60 cm (without tail) both ovaria together weighed 63.82 gr and contained about 160.000 eggs.

After spawning the ovarium is an empty bag, but soon young eggs can be seen regenerating from a strip of tissue along the mesovarium. How often they spawn during lifetime cannot yet be said. In a single sample of mature fishes one can find at any time ovaries in every stage of ripening.

As to the question, whether there are one or two species, the following remarks may be made.

I do not think it necessary to give here the full descriptions of the two species, as BLEEKER has done that already. As there are of course many points in which they agree, I think it better to lay stress upon the differences.

BLEEKER himself evidently found it rather difficult to distinguish the two species. In his Atlas, after the descriptions, he writes as follows:

„Sur deux individus d'une longeur de 442‴ ces differences se traduisent comme suit.

Chirocentrus dorab. Hauteur du corps 7 fois dans sa longueur sans la caudale. Hauteur de la tete 1⅔ fois dans sa longueur sans la mâchoire inferieure. Hauteur de la queue près de la base de la caudale 3 fois dans la distance entre la dorsale et la caudale. Tête 6 fois dans la longueur du corps sans la caudale. Ecailles visiblement plus petites que dans l'*hypselosoma.*

Chirocentrus hypselosoma. Hauteur du corps 5½ fois dans sa longueur sans la caudale. Hauteur de la tête 1⅓ fois dans sa longueur sans la mâchoire inferieure. Hauteur de la queue près de la base de la caudale 2⅓ fois dans la distance entre la dorsale et la caudale. Tête 5⅔ fois dans la longueur du corps sans la caudale. Ecailles visiblement plus grandes que dans le *dorab*".

From these descriptions it follows that *Ch. dorab* is the more slender species. This tallies with the fact that *Ch. dorab,* as will be pointed out below, has from two to four vertebrae more than *hypselosoma.* In agreement with the more slender body *Ch. dorab* has a head which is not as high as that of *hypselosoma* (cf. below).

I have studied the following characteristics considered by BLEEKER already [1]) and have added a few of my own.

LENGTH: HEIGHT.

According to BLEEKER this is 5½ for *hypselosoma* and 7 for *dorab*. In Table nr. I I give some measurements of my own.

In this and the following tables I have taken one sample of *Chirocentrus dorab* from Batavia consisting of fishes of about 40 cm. I took three samples of *hypselosoma* (Bagan I, Bagan II, Batavia), of different size. The sample Bagan I was collected at Bagan-si-Api-Api (Sumatra) in January 1929 and consists equally of fishes of about 40 cm. Bagan II was collected at Bagan in October 1929 and contains young fishes of about 10 - 20 cm. The *hypselosoma* sample from Batavia has very big fishes of about 60 - 80 cm. I have chosen these three different samples in order to see if there were differences in the measurements due to size (age). As the specimens of my sample of what I call *dorab* are all the same size (40 cm), I could not give three different sizes for this species too. I have computed all quotients up to one decimal.

Table I. Length : Height.

Quotients	N	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
dorab. . . Batavia	34								1	1					1			2			3		5	3	2	1	3	3	3	2			2	2
hypselosoma Bagan I	36						2	4	1	6	4	4	6	1	3	1		2	1	1														
hypselosoma Bagan II	27		1		4	2	2	2	4	3	4	3	1		1																		
hypselosoma Batavia	37		4	2	1	1	2	6	3	4	4	5	1	1		1	1						1										

As we see in Table nr. I the range of the quotients for *Chirocentrus dorab* is from 5.6 to 8.1 with the maximum between 7.0 and 7.7. For *hypselosoma* the range is from 5.0 to 7.0 with the maximum between 5.0 to 6.0. The difference between *dorab* and *hypselosoma* is very evident, although it is not always possible to say to which species each single fish belongs, if we consider this characteristic only.

After multiplying the quotient with 10, to avoid superfluous decimals, we find for *dorab* the average 71.70 ± 1.01 (standard error). The average for *hypselosoma* of the same size (Bagan I) is 55.67 ± 0.56. The difference is $16.03 \pm \sqrt{1.01^2 + 0.56^2} = 16.03 \pm 1.15$. As 16.03 is much more than three times 1.15 we have a real and very evident difference between *dorab* and *hypselosoma* [2]).

[1]) Following closely the methods of BLEEKER.

[2]) I compared only the *hypselosoma* sample Bagan I with *dorab*, the others being of different size.

The average for Bagan II is 59.09 ± 0.54. The difference between the samples Bagan I and Bagan II is 3.52 ± 0.77 and is a real one. This is due perhaps to the different size (age). The average for *hypselosoma* from Batavia is 56.44 ± 0.68. The difference between this and the sample Bagan II is 3.65 ± 0.86, a real one too and possibly due to size. When comparing Batavia with Bagan I (both consisting of adult fishes though of different size) the difference is 0.77 ± 0.87 and thus there is no true difference between them. Therefore the difference between the two samples of adult fishes on the one side and the collection of young fishes from Bagan on the other side (Bagan II) is probably due to the difference in size only. Later on, indeed, we still see that in dealing with *Ch. hypselosoma* we will have to take account of the possibility of racial differences also.

LENGTH OF THE HEAD: HEIGHT OF THE HEAD.

According to BLEEKER the quotient for *dorab* is 1.6 - 1.7 and for *hypselosoma* 1.3 - 1.4 (see Table nr. II).

Tablê II. Length of the head : Height of the head.

Quotients	N	12	13	14	15	16	17	18
Ch. dorab . . . . . Batavia	34		1	2	8	19	4	
Ch. hypselosoma . . . . . Bagan I	36		1	10	17	6	2	
Ch. hypselosoma . . . . . Bagan II	27			3	20	4		
Ch. hypselosoma . . . . . Batavia	37		8	23	5	1		

My figures for *dorab* are about the same as those given by BLEEKER. For *hypselosoma* I find for the first two samples slightly more.

The average for *dorab* is 15.68 ± 0.14 and for *hypselosoma* of the same size (Bagan I) 14.95 ± 0.16. The difference is $0.73 \pm \sqrt{0.14^2 + 0.16^2} = 0.73 \pm 0.21$. As 0.73 is more than three times 0.21, the difference between *dorab* and *hypselosoma* of equal size is real.

Now, if we compare the three samples of *Ch. hypselosoma* mutually we find as follows.

The average for the sample Bagan II is 15.03 ± 0.11. Calculation shows that there is no real difference between Bagan I and Bagan II. For the big *Ch. hypselosoma* from Batavia we find the average 13.98 ± 0.11. If we compare this with Bagan I and Bagan II we find 0.97 ± 0.19 and 1.05 ± 0.15 resp., and thus a real difference. Whether this is due to size only or to the samples belonging to two races of the same species we cannot say yet. I had from Batavia only two specimens of *hypselosoma* of 20 cm (not given in the table). As these

have both the quotient 1.5 (like Bagan I and Bagan II) the difference found may be due to size only.

DISTANCE CAUDALIS-DORSALIS: HEIGHT OF CAUDAL PEDUNCLE.

According to BLEEKER the quotients are 3.0 for *dorab* and 2.3 - 2.4 for *hypselosoma*. (see Table III).

Table III. Distance caudalis-dorsalis : Height of caudal peduncle.

Quotient	N	20	21	22	23	24	25	26	27	28	29	30	31
Ch. dorab . . . . . Batavia	34					3		5	6	5	8	6	1
Ch. hypselosoma . . . Bagan I	36				4	8	6	7	6	3	1	1	
Ch. hypselosoma . . . Bagan II	27	1	3	8	10	2	3						
Ch. hypselosoma. . . . . Batavia	37				7	16	7	5	2				

As the average for *Ch. dorab* is 27.86 ± 0.35, for *hypselosoma* (Bagan I) 25.86 ± 0.25 the difference is 2 ± 0.43, which is a real one.

For the small *hypselosoma*'s (Bagan II) the average is 22.67 ± 0.23. As difference between the two samples from Bagan we find 3.19 ± 0.33. This difference, therefore, is real and according to what we found before, probably due to size.

The average for Batavia is 24.42 ± 0.18. Comparing this with the sample Bagan II the difference is 1.75 ± 0.29, and thus again a real one. When comparing with Bagan I the difference is 1.44 ± 0.30, which is also a true one.

Judging from these three differences, we can hardly avoid concluding that there is a difference due to size (age) as well as to race. For if the difference were due to size only the average from Batavia would be higher than that for Bagan I. The *hypselosoma* from Batavia seems to belong to another race as the *hypselosoma* from Bagan (cf. also what is said on the influence of sex below).

Table nr. III shows that when considering this characteristic, we find a difference between *dorab* and *hypselosoma*. A difference, however, which again does not enable us to recognize each single specimen at hand.

LENGTH OF BODY: LENGTH OF THE HEAD.

This quotient is, according to BLEEKER, for *dorab* 6.0 and for *hypselosoma* 5.6 - 5.7 (see Table nr. IV).

The average for *Ch. dorab* is 58.30 ± 0.33. The average for *hypselosoma* of Bagan I is 52.84 ± 0.31. The difference is 5.46 ± 0.45, a true one. In both cases my figures are somewhat lower than those found by BLEEKER.

Table IV. Length of Body: Length of Head.

Quotient	N	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Ch. dorab. . . . . Batavia	34									1		1	3	7	6	6	8	1			1
Ch. hypselosoma . . Bagan I	36						3	9	5	6	3	8	1	1							
Ch. hypselosoma . . Bagan II	27			1		4	9	4	4	3	2										
Ch. hypselosoma . . Batavia	37									1	1	6	8	11	5	1	2	1		1	

The average for *hypselosoma* of Bagan II is 50.81 ± 0.31. The difference with the sample Bagan I is 2.03 ± 0.43, a true one.

The average for *hypselosoma* from Batavia is 56.90 ± 0.30. The difference with Bagan II is 6.09 ± 0.43 and with Bagan I 4.06 ± 0.43, in both cases a real one. We see from this that some of the differences must be due to age. The young fishes from Bagan II have the lowest average, next comes the average of Bagan I and after that the big fishes of Batavia.

Whether the big average of the Batavia sample is due to the bigger size only or partly to race characters also, we cannot conclude yet from these figures.

SCALES.

The scales are very deciduous and it is difficult to find a specimen on the market with any scale left on it. The scale pouches are often difficult to distinguish (as big patches of the skin are flattened in preserved fishes). This renders it difficult to count their number on the linea lateralis and transversalis. As a fact no author mentions them in his description. The scales, if normal, are oval and finely striated in transverse direction. In many scales the striae are irregular, and it is sometimes difficult to find a normal one. They seem to be exposed to many injuries.

BLEEKER says *hypselosoma* has the biggest scales. I found on the contrary, that this is the case with *dorab*. I suppose this must be a mistake of the author. I considered only the scale pouches as I had no opportunity to compare the scales of two individuals of the same size of both species.

The number of scales in the transversalis near the dorsal fin (between the linea lateralis and the back) amounts for *dorab* to about 20 and for *hypselosoma* to about 25.

It was impossible for me to count the scales along the linea lateralis.

FIN FORMULAE.

BLEEKER gives the following figures for the fin formulae:

Ch. dorab D. 4/12 - 4/13 P. 1/12 - 1/13 V. 1/6 A. 1/27 - 4/32 C. 1/15/1.

Ch. hyp. D. 4/12 - 4/13 P. 1/11 - 1/13 V. 1/5 - 1/6 A. 1/25 - 3/30 C. 1/17/1.

My figures for the P. dorsalis are the same as given by BLEEKER for the two species. In a very few cases only I found 3 unbranching rays.

In examining the pectorals I found some difference. Counting the fin rays of 30 *Ch. dorab* I got 4 times 1/12, 25 times 1/13 and 1 time 1/14, being about the same as what BLEEKER found.

In 30 *Ch. hypselosoma* I counted 10 times 1/13 and 20 times 1/14, being somewhat more than BLEEKER found. Thus there is evidently some difference between *hypselosoma* and *dorab*, although again not sufficient to distinguish each single specimen by it.

About the ventrals I have no remarks, my figures being the same as those of BLEEKER.

Counting the rays of the anal fin I found for *Ch. dorab* the same figures as BLEEKER, but for *hypselosoma* 4/28-32, being about the same as in *dorab*.

I do not know what made BLEEKER write down 1/25 - 1/30. Of course it may be possible that there exists somewhere a race with a different number of fin rays, but it may be a mistake also.

BLEEKER gave a difference of 2 rays between the two species for the P. caudalis. I counted always 1/17/1 and sometimes 1/16/1 in both. His statement 1/15/1 for *dorab* is probably wrong.

GILL-RAKERS.

The gill-arches bear some strong, flattened, spinulated gill-rakers. I found their number to be a very good characteristic to distinguish the two species.

Deviating from the ordinary practice I counted all the gill-rakers on the whole gill-arch. The first number is that of the upper half, the second of the lower half.

For *Ch. dorab* I found on the upper half mostly 3. Out of 77 cases I found 5 times 2, 6 times 4 and 66 times 3 gill-rakers. On the lower half the numbers ranged from 17 - 13, being 1 time 17, 8 times 16, 31 times 15, 26 times 14 and 11 times 13. (see Table nr. V).

Table V. *Ch. dorab*. Number of Gill-Rakers.

	Upper half			Lower half				
Number of gill-rakers . . .	2	3	4	13	14	15	16	17
Number of cases	5	66	6	11	26	31	8	1

For *Ch. hypselosoma* the matter is somewhat more complicated as very large specimens seem to loose part of their gill-rakers. At least in big fishes there are gaps between the gill-rakers where scars may be seen. This will probably be the case with *dorab* too, but I do not possess a specimen bigger than about 40 cm and up to that range *hypselosoma* specimens are behaving normally.

The upper half of the gill-arch of *hypselosoma* bears 5 gill-rakers (the number ranging from 4 - 6, but far the greater part of the specimens having 5).

Taking into consideration 83 specimens under 50 cm., I found 19 times 4, 65 times 5 and 4 times 6 gill-rakers. (see Table nr. VI). In bigger specimens I found from 3 to 2 gill-rakers, but when counting the scars also, their number rose to 5 and 6.

Table VI. *Ch. hypselosoma*. Number of Gill-Rakers.

	Upper half			Lower half					
Number of gill-rakers.	4	5	6	14	15	16	17	18	19
Number of cases . . .	19	65	4	8	5	20	34	14	2

On the lower half of the gill-arch I noticed in the same 83 animals 14 - 19 gill-rakers, respectively 8, 5, 20, 34, 14, and 2 times.

In big ones I counted numbers from 8 to 12 without scars and 16 - 17 the scars included.

This characteristic is an easy one to distinguish the two species by. The commonest numbers for *dorab* being 3 - 14/15 and for *hypselosoma* 5 - 16/17. The real numbers are only slightly overlapping each other.

LENGTH OF THE UPPER JAW.

Another very good characteristic, by which to distinguish the two species, if the specimens are not too small, is the length of the upper jaw. Specimens of *hypselosoma* have the maxillary reaching to over the praeoperculum, while specimens of *dorab* have some distance left between the praeoperculum and the end of the jaw.

This is a very important characteristic that always holds good. Only in very young fishes, as for instance those from the sample Bagan II, both species have the jaw of the same length, not reaching the praeoperculum. But the older ones are always to be recognized by it at first glance.

NUMBER OF VERTEBRAE.

Considering the number of vertebrae we find also some difference between the two species.

First I will mention the numbers I found for *Ch. dorab*. I used samples from Singapore, from Batavia (western part of Java), from Cheribon, in the middle part, and from Toeban, in the eastern part of Java. For the praecaudal vertebrae I got the following numbers (see Table nr. VII).

When calculating the differences we find that there is no real one between the samples from Singapore and Batavia, and between those of Cheribon and Toeban. But if we compare Cheribon and Batavia we find 0.89 ± 0.33, and

The upper half of the gill-arch of *hypselosoma* bears 5 gill-rakers (the number ranging from 4 - 6, but far the greater part of the specimens having 5).

Taking into consideration 83 specimens under 50 cm., I found 19 times 4, 65 times 5 and 4 times 6 gill-rakers. (see Table nr. VI). In bigger specimens I found from 3 to 2 gill-rakers, but when counting the scars also, their number rose to 5 and 6.

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Number of gill-rakers.	4	5	6	14	15	16	17	18	19
Number of cases . . .	19	65	4	8	5	20	34	14	2

On the lower half of the gill-arch I noticed in the same 83 animals 14 - 19 gill-rakers, respectively 8, 5, 20, 34, 14, and 2 times.

In big ones I counted numbers from 8 to 12 without scars and 16 - 17 the scars included.

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Table VII. *Ch. dorab.* Praecaudal Vertebrae.

Locality	Vertebrae					N	Average	Standard error
	42	43	44	45	46			
Singapore	2	6	3	8		19	43.89	± 0.24
Batavia	3	11	16	4		34	43.61	± 0.13
Cheribon			4	1	1	6	44.50	± 0.31
Toeban		4	8	6		18	44.11	± 0.17

Toeban and Batavia 0.50 ± 0.21. Therefore there are some indications, but no certainty, that the specimens from Cheribon and Toeban belong to another race.

Something similar is found in other Clupeid genera also (investigations not published yet). In the clear water with higher salinity of the eastern part of Java sea there seem to live other races with a higher number of vertebrae than in the western half.

Now *Chirocentrus* is a fish not living in shoals and nothing is known about their migrations, if there are any. Therefore we have no proof that two specimens caught at the same place always belong to one and the same race. Mixed catches may occur. Only with material much larger than mine this problem can definitely be solved.

The caudal vertebrae are dealt with in Table nr. VIII. In their numbers the hypural is included.

Table VIII. *Ch. dorab.* Caudal Vertebrae.

Locality	Vertebrae					N	Average	Standard error
	28	29	30	31	32			
Singapore		6	8	4	1	19	30.00	± 0.19
Batavia	1	4	22	3	4	34	30.14	± 0.15
Cheribon	1	2	2	1		6	29.50	± 0.39
Toeban	2	5	10	1		18	29.55	± 0.18

Calculating the differences shows us that there are hardly any between the four samples.

In Table nr. IX the total number of vertebrae are given.

The differences found in Table nr. IX are not sufficient to allow any conclusion.

The numbers in Tables nr. VIII and nr. IX do not give support to the admittance of different races as suggested by table nr. VII. Therefore I think

Table IX. *Ch. dorab.* Total Number of Vertebrae.

Locality	Vertebrae				N.	Average	Standard error
	72	73	74	75			
Singapore		4	13	2	19	73.89	± 0.12
Batavia	2	10	16	6	34	73.76	± 0.13
Cheribon		1	4	1	6	74.00	± 0.23
Toeban	1	7	8	2	18	73.72	± 0.19

it better to assume for the present that there are no different races in *Ch. dorab*, the indications at hand being insufficient.

The three following tables deal with *Ch. hypselosoma*. I got samples from Bagan-si-Api-Api (Strait Malacca), Singapore, mouth of the Palembang river, mouth of the Panei river (north of Bagan) and Batavia. From Bagan-si-Api-Api I got two samples (see above), also from Singapore. I bought at the fishmarket of Singapore two different samples, one containing fishes of about 60 cm and the other of about 40 cm which proved to be different.

In Table nr. X the number of the praecaudal vertebrae is given.

Table X. *Ch. hypselosoma.* Praecaudal Vertebrae.

Locality	Vertebrae							N.	Average	Standard error
	39	40	41	42	43	44	45			
Panei river				1	2	1		4	43.00	± 0.35
Bagan I			10	18	8			36	41.95	± 0.11
Bagan II	1		8	13	3	2		27	41.85	± 0.19
Singapore (big)					5	7		12	43.58	± 0.14
Singapore (medium)			4	6	1	1		12	41.91	± 0.24
Palembang river				3	3	3		9	43.00	± 0.27
Batavia				1	19	16	1	37	43.45	± 0.09

From this table we see that the samples Bagan I and II show no difference. One of the Singapore samples seems to belong to the same group. In the same way the other sample from Singapore (big size) and the one from Batavia belong together as there is hardly any difference between them.

Only the small collections from the mouth of the Palembang and Panei rivers are somewhat different from the Singapore-Batavia group, but this difference is not sufficient to conclude with certainty that they belong to another race. This we may say that there are most probably two different races to be distinguished here, a result we have found also when comparing the relation between the distance caudalis-dorsalis and the height of the caudal peduncle.

Table nr. XI gives the number of caudal vertebrae.

Table XI. *Ch. hypselosoma*. Caudal Vertebrae.

Locality	Vertebrae					N	Average	Standard error
	26	27	28	29	30			
Panei river			3	1		4	28.25	± 0.21
Bagan I	1	3	17	15		36	28.08	± 0.13
Bagan II		3	11	12	1	27	28.40	± 0.14
Singapore (big)		1	8	3		12	28.16	± 0.15
Singapore (medium)		2	3	6	1	12	28.50	± 0.25
Palembang river		1	3	5		9	28.44	± 0.23
Batavia		5	17	14	1	37	28.29	± 0.12

The averages are all about the same. Real differences are not to be found.

The total numbers give again some evidence of the existance of different races, as will be shown in Table nr. XII.

Table XII. *Ch. hypselosoma*. Total Number of Vertebrae.

Locality	Vertebrae							N	Average	Standard error
	67	68	69	70	71	72	73			
Panei river				1	1	2		4	71,25	± 0.42
Bagan I		2	3	21	6	4		36	70.19	± 0.16
Bagan II	1		4	12	6	4		27	70.25	± 0.12
Singapore (big)					4	7	1	12	71.75	± 0.17
Singapore (medium)			2	5	4		1	12	70.41	± 0.30
Palembang river					5	4		9	71.44	± 0.16
Batavia			1		10	21	5	37	71.78	± 0.12

In Table nr. XII we see again that the samples Bagan I and Bagan II and Singapore (medium size) belong to one group and Singapore (big size) and Batavia to another group. Further investigations will have to settle this question, whether the different samples in one group belong to one or more races. As shown in Table nr. XII the small samples from the Panei and Palembang rivers are intermediate again between the two groups; I do not know yet what this means. Perhaps a future publication may clear up this problem.

As will be seen at a glance when comparing the Tables nrs. X, XI ,XII and the Tables nrs. VII, VIII and IX, there exists a big difference in the number of praecaudal and caudal vertebrae as well as in the totals in *Ch. dorab* and *hypselosoma*.

From all the foregoing considerations it is evident that BLEEKER was right in distinguishing two species of *Chirocentrus* of which the eggs have been described by Dr. DELSMAN. There are indications that each of these two species consists of a number of local races but the evidence at hand is not sufficient

to settle this question definitely. An additional difficulty in solving this problem is afforded by what follows.

SEX RATES.

Examining the *hypselosoma*'s from Batavia I noticed a very peculiar fact. They were all of the feminine sex. Out of 37 I got one male only of 47 cm (tail excluded), the smallest of the whole sample. As this fact struck me I counted males and females in other samples too. The results are given in Table nr. XIII.

Table XIII. *Ch. hypselosoma*. Numbers of females and males.

Locality	♀	♂	Remarks
Panei river	3	1	
Bagan I	6	30	size 30-40 cm.
Bagan II.	—	—	fishes too young to determine the sex.
Singapore (big)	12		size up to 60-70 cm.
Singapore (medium) . .	1	11	size about 40 cm.
Palembang river . . .	7	2	the fishes from 30-60 cm. The two ♂♂ resp. 32 and 33 cm.
Batavia	36	1	the smallest one.

From this table we see that in the different samples there are either considerably more ♀♀ or more ♂♂. In the samples containing fishes of big size (Singapore, Palembang river and Batavia) there are more females. The males belong mostly to the samples with smaller specimens.

This is very interesting for two reasons.

In the first place the samples containing mostly females or males agree with those samples in Tables nr. X, XI and XII which have a higher or lower number of vertebrae. For this reason it is possible that the assumed race differences given above are partly due to sex only. (cf. LO GIUDICE "Salle diverse razze locali o 'Famiglie' (Heincke) di acciughe" Rivista mensile di Pesca e Idrobiologica 1911).

But on the other hand there is the curious fact to be noticed, that in some localities there are practically females only and that in other the males have by far the majority.

In the vicinity of Batavia it is possible that only the big females are caught, assuming that *Chirocentrus* has dwarf males. The fishes are caught with big gillnets and the smaller males may escape. In this way we may get unreliable figures. I do not know by which means my Singapore specimens have been caught and thus it is possible that in assorting them the smaller males were separated from the bigger females. But this is certainly not the case with the specimens from Bagan-si-Api-Api, which are caught in fish traps

that do not give an opportunity to escape even to the smallest fry. One should therefore expect here about as many males as females.

I cannot give a satisfactory explanation of the facts mentioned above. Perhaps further investigations will contribute to solve this question.

I think, we are justified in assuming that the males of *hypselosoma* are smaller than the females. So the samples Bagan I and Singapore (medium size) contain most males. In the sample from the Palembang river the two smallest specimens are males and the same may be seen in the collection from Batavia as in the big sized specimens from Singapore.

The numbers for *Ch. dorab* are given in Table nr. XIV.

Table XIV. *Ch. dorab*. Numbers of males and females.

Locality	♂	♀	Remarks
Singapore	43	6	
Batavia	18	16	
Cheribon	4	2	
Toeban	15	3	

Nothing can be concluded with certainty from the data given above. There are perhaps more males than females. As all fishes are of the same size I cannot make out if in *dorab* the males are the smallest as well.

DISTRIBUTION.

About the distribution of the two species there is still much to be elucidated They exclude each other by no means. In a single catch specimens of *dorab* as well as of *hypselosoma* may be found. Yet in the waters of relatively low salinity in the neighbourhood of Bagan-si-Api-Api and the mouth of the Panei river I have found during my two visits (January and October 1929) the species of *hypselosoma* only. In Singapore the two species are to be found and in the mouth of the Palembang river too. I got from there a sample of 10 specimens including 9 *hypselosoma* and 1 *dorab*. In Batavia the two species are found, *dorab* near the coast and *hypselosoma* at some distance from it. One should expect the contrary, as *hypselosoma* is found in the brackish to salt waters of Bagan-si-Api-Api. But, as pointed out above, there is evidence that they belong to different races. In the neighbourhood of Batavia the *dorab* is mostly immature, *hypselosoma* is quite full grown and the fishes are mostly very large, up to 90 cm. I never saw a *dorab* as big as that. The young individuals of *hypselosoma* seem to live far away from the coast too, as a thorough search at the fishmarkets of Batavia in the catches of the coastfishermen yielded two young ones only. I have examined some hundreds of smaller *Chirocentrus*, but all belonged to *dorab*.

As a matter of fact only six month ago it was not known to me that *hypselosoma* occurred in the Java sea. They are caught by the gillnets only which Japanese fishermen introduced quite recently.

I have not found *hypselosoma* east of Batavia, but BLEEKER mentions them, as far as the Moluccas. I once got a *Chirocentrus* in Toeban, which unfortunately was lost afterwards. It had a total number of vertebrae of 67. Judging from this it may have been *hypselosoma*. At that time I had not yet studied the differencies between the two species. Thus I do not know with certainty to which species it belonged.

As a matter of fact I think it very probable that *hypselosoma* will be found along the whole north coast of Java, if the right kind of fishing gear is used. This opinion is supported by Dr. DELSMAN's results concerning the distribution of the two kinds of eggs.

SUMMARY.

The genus *Chirocentrus* consists of two species, *Chirocentrus dorab* FORSK. and *Chirocentrus hypselosoma* BLEEKER.

The differences between the two species are:

a. a statistical difference in the relation length : height.
b. a statistical difference in the relation length of the head : height of the head.
c. a statistical difference between the relation distance caudalis-dorsalis : height of caudal peduncle.
d. a statistical difference in the relation length of body : length of head
e. *Ch. dorab* has the bigger scales of the two.
f. *Ch. dorab* has mostly one ray more in the pectoral fin than has *hypselosoma*.
g. the gill rakers number for *dorab* mostly 3/15 - 14 and for *hypselosoma* 5/16 - 17.
h. *Ch. dorab* has the heigher number of vertebrae (about 2 - 4) of the two.
i. the *Ch. hypselosoma* specimens have the maxillary reaching to over the praeoperculum while specimens of *dorab* have some distance left between the latter and the end of the jaw.

From the figures given, especially from those of the vertebrae, the conclusion may be drawn, that there are perhaps some differences between the samples of *Ch. dorab*.

Between those of *Ch. hypselosoma* there are real ones, partly due to size (age), partly due to race. Racial characters which perhaps might prove to be sex differences only, as in the samples from different localities either the number of males or females predominates.

There is evidence that the males of *Ch. hypselosoma* are much smaller than the females.

LITERATURE:

1. *Clupea dorab*. FORSKAL. Descript. Animal. 1775 p. 72.
2. *Chirocentrus dorab* CUVIER et VALENCIENNES. Hist. Nat. de Poiss. XIX 1846 p. 150.
3. *Chirocentrus hypselosoma*. BLEEKER. Nat. Tijdschr. Ned. Indië III 1852 p. 71.
4. *Chirocentrus dorab*. GUNTHER. Cat. Brit. Mus. VII 1868 p. 475.
5. *Chirocentrus dorab*. BLEEKER. Atlas Ichth. VI 1866 - 1872 p. 92.
6. *Chirocentrus hypselosoma*. BLEEKER. Atlas Ichth. VI 1866 - 1872 p. 93.
7. *Chirocentrus dorab*. DAY. Fishes of India. 1878 - 1888 p. 652.
8. *Chirocentrus dorab*. JORDAN and HERRE. Proc. U. S. Nat. Mus. XXXI 1906 p. 641.
9. *Chirocentrus dorab*. JORDAN and SCALE. Bulletin Bureau of Fisheries Vol. XXVI 1906 p. 4.
10. *Chirocentrus dorab*. GÜNTHER. Fische der Südsee. Heft VIII 1909 p. 641.
11. *Chirocentrus dorab*. WEBER and DE BEAUFORT. The Fishes of the Indo-Australian Archipelago II 1913 p. 18.
12. *Chirocentrus dorab*. DELSMAN. Fish Eggs and Larvae from the Java Sea 2. *Chirocentrus dorab*. Treubia Vol. III 1922 p. 38.
    15. On *Chirocentrus hypselosoma* and *dorab*. Treubia Vol. VII 1930 p. 46.
13. *Chirocentrus dorab*. DERANIYAGALA. Ceylon Sardines. Spolia Zeylanica. Vol. XV p. 32.