ACKNOWLEDGEMENTS

I am indebted to several persons for manifold courtesies and helpful cooperation, throughout the course of this work. Particularly, I wish to express my deep sense of gratitude to Drs. Sunder Lal Hora, Leonard F. Schultz, Ethelwyn Trewavas, George S. Myers, who not only lent nearly their entire collection of bagrid material but also read through many drafts of portions of this Thesis, gave information regarding types in their collection, and suggested many improvements. Dr. Ernest A. Lachner gave useful hints for presenting statistical comparisons. Profs. W. A. Gosline and W. I. Follett undertook the task of reading drafts of nomenclatural validity of the generic name Mystus and suggested constructive steps for a solution of the difficult problem. Dr. M. L. Roonwal, Director, Zoological Survey of India gave me laboratory facilities. Dr. M. S. Mani, Deputy Director in the same department, helped me by reading some portions of this Thesis and in duplicating certain drawings by photography, and Sri. A. K. Mondal, Artist in the same department, executed most of the drawings and graphs under my direct supervision and guidance. To all these gentlemen, I offer my sincere thanks.

METHODS OF STUDY AND PRESENTATION

The arrangement and descriptions of various genera and species follow a uniform pattern. In the discussions after the generic description, the various systematic and
nomenclatural changes undergone by the genus, if any, are included. The keys and comparisons of species often give a range of proportional measurements and counts greater than that shown in the description. These differences are the result of using the data of additional extralimital specimens, recorded in published literature. However, in all these cases only such data based on correct identifications are included.

STATISTICAL METHODS.— The statistical work in this Thesis is based on formulae and tables found in Simpson & Roe (1939) and Snedecor (1946). No two species, whose total count of the samples is less than 25, have been statistically compared. But, two samples of a single species with $N_1 + N_2$ less than 25 are compared; in all these cases the results are only discussed and not implemented. This is done with a view that they could be further tested, if so desired, on similar lines with larger material.

The graphical representation of the variations are as proposed by Dice & Lerasa (1936), modified by Hubbs & Perlmutter (1942) and Clark Rubbs (1952). Another modification introduced in this Thesis is to arrange the graphs face to face, when only two samples are compared. This facilitates easier comparison of the overlapping standard deviations. The various examples of graphs used are shown in Figure 1.
KEYS.— In many cases, the keys are only provisional. The genera, tribes and subfamilies are considered in the same order as in the key, but the species are arranged according to their affinities.

SYNONYMY.— A complete list of synonyms for each genus and for each species is given. References containing some records of specimens from different localities are listed under species synonymy. All place names have been checked for their spellings and corrected as in Bartholomew (1920, 1923, 1951, 1956), Smith (1945, pp. 17-28). Where no specific pin-point type locality is given, a new one is selected or the old one revised in the light of recommendations of Smith (1955). The abbreviations of the periodicals are those given by the World List of Scientific Periodicals (1952).

SPECIMENS STUDIED.— Under this heading, the various symbols used for the catalogue numbers of specimens in the various institutions are as below.—

AMNH American Museum of Natural History, New York, U. S. A.

BMNH British Museum of Natural History, London, U. K.

MCZ Museum of Comparative Zoology, Harvard, Mass., U. S. A.

MRGB Museum Royal du Congo Belge, Tervueren, Belgian Congo.

RMF Raffles Museum, Singapore, Malaya.

RML Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

SNHM Stanford Natural History Museum, Stanford University, Stanford, California, U. S. A.


VNM Naturhistorisches Museum, Wien, Austria.

ZMA Zoological Museum, Amsterdam, Netherlands.
ZMB Zoological Museum, Berlin, Germany.
ZSI Zoological Survey of India, Calcutta, India.

The details given are as in the original labels, but the locality names have been checked for their spellings and corrected as in the Gazetteers referred to earlier. The tentative identifications on the original labels are ignored.

DESCRIPTION.— When the description is based upon the examination of more than one specimen, the initial value given in the text is the arithmetic mean of all the specimens measured; the values cited within brackets are the extremes. Unless otherwise stated, the values given for each proportional measurement or count are as shown by all the specimens studied. Proportional measurements, and counts not given in the description are recorded in separate tables. The counts of fin rays represent the total number of branched and simple rays, but in cases where some significance is indicated, they are given separately. Counts of dorsal and pectoral spine serrations are given only in cases where each teeth could be separately counted.

COLOUR.— This heading included a description of the basic colour pattern as observed in the alcoholically preserved specimens, unless otherwise stated.

DISTRIBUTION.— The distribution gives all the localities from where the species has been so far recorded. Only correct records are included. The place names have been
checked and corrected for their spellings and arranged under
their respective geographic situations as given in the
Gazetteers referred to earlier; doubtful names are placed
within inverted commas.

RELATIONSHIP.— The nearest relative of the concerned species
as judged by my study, and the important characters by which
they can be separated are given under this heading. In some
cases, their probable taxonomic status is also indicated.

REMARKS.— Under this section miscellaneous information
concerning the relationships among closely related species
and subspecies, their comparisons, comments on literature,
possible synonyms, justifications for synonymizing some
taxons and notes on variations are given.

BIBLIOGRAPHY.— A nearly complete list of references on
this family is given under this heading.

DEFINITION OF TERMS.—

Measurements

STANDARD LENGTH is the distance from the anteriormost tip
of snout or upper lip to midbase of caudal fin (end of the
hypural fan).

BODY DEPTH is the greatest vertical distance of the body at
its deepest part.

HEAD LENGTH is the distance from the anteriormost tip of
snout or upper lip to the rear end of fleshy operculum.

HEAD WIDTH is the greatest horizontal distance across the
opercles. If the opercles are dilated they are forced into
a reasonably normal position.
HEAD DEPTH is the vertical distance from the middorsal line at the base of the occipital process to the midventral line of the breast.

SNOUT LENGTH is the distance from the anteriormost tip of snout or upper lip to the hard front margin of the orbit.

EYE DIAMETER is the greatest distance between the margins of the bony orbit.

INTERORBITAL WIDTH is the least distance between the edges of the orbit on the dorsal surface of the head.

PREDORSAL LENGTH is the distance from the anteriormost tip of snout or upper lip to the posterior end of the predorsal plate.

POSTDORSAL LENGTH is the distance from the posterior end of the predorsal plate to the midbase of the caudal fin.

PREPELVIC DISTANCE is the distance from the anteriormost tip of snout or upper lip to pelvic insertion.

LENGTH OF DORSAL AND OF PECTORAL SPINE is the distance from the base of the spine to the tip, the filaments if any, excluded. Usually a somewhat short spine-like extension is fused with the base of the long dorsal spine. This spine is not measured. The base of the spine is the structural base which is determined by sliding the tip of the dividers along the prolongation of the dorsal or pectoral origin until it "hooks" into the base.

CAUDAL PENDUNCLE LENGTH is the distance from the rear end of the anal fin base to the midbase of the caudal fin.

CAUDAL PENDUNCLE DEPTH is the least vertical distance at its narrowest part.
LENGTH OF PECTORAL AND OF PELVIC FIN is the distance from the base of the outermost ray to the distal tip of the fin. Filamentous prolongations, if any, are excluded.

LENGTH OF BASE OF DORSAL, ANAL, AND ADIPOSE FIN is the greatest distance from the base of the first ray to the posteriormost point where the membrane behind the last ray contacts the body. In the case of the adipose dorsal fin, it is the distance from the origin of the fin to its posteriormost point.

LENGTH OF DORSAL, OF ANAL, AND OF CAUDAL FIN is the length of the longest ray from the base to its distal tip. Filamentous elongations, if any, in the case of the caudal fin, are excluded.

WIDTH OF GAPE OF MOUTH is the greatest transverse distance across the opening of the mouth.

BARBELS are measured from their base to their distal tip or termination, when kept straight.

Counts

BRANCHIOSTEGALS.- All branchiostegal rays are counted.

GILL RAKERS.- The anteriormost right arch is dissected out and all rudiments on the first arch included in the counts.

FIN RAYS.- The first dorsal fin is only taken into consideration since the second dorsal fin is adipose and usually smooth (exception Garortes Kner). Spines are represented by Roman characters; simple soft rays by lower case Roman, and branched rays by Arabic numbers. Each ray with a separate base is
counted. When the last ray is divided down to a single base, it is counted as one ray. In the case of the anal fin, some simple rays lie near the origin of the fin. These rays also are included by dissecting the fleshy skin covering them.

**VERTEBRAE.** - The first caudal vertebra is the one bearing a definite haemal spine. It was not possible to examine many specimens of any species and in some cases no specimen was counted because of museum regulations against dissection. In some cases radiographs were utilised. By this method however, only the total count is obtained, since the haemal spines are not discernible clearly. More refined techniques could not be adopted for lack of facilities.

**PRECAUDAL VERTEBRAE.** - Vertebrae situated above the abdominal cavity with unjointed spiny processes or without them. For practical purposes all vertebrae anterior to the anteriormost, hard anal fin ray are counted as precaudal vertebrae.

**CAUDAL VERTEBRAE.** - All vertebrae posterior to the anteriormost hard anal fin ray are counted as caudal vertebrae.

**CAUDAL FIN RAYS.** - Unless otherwise stated, the count of caudal fin rays given is of the principal rays.

**ABBREVIATIONS.** - Certain abbreviations and concretions used are as below:

**Measurements**

<table>
<thead>
<tr>
<th>SL</th>
<th>Standard length</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH</td>
<td>Head length</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Int. Orb. Wdh.</th>
<th>Interorbital width</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCPD</td>
<td>Length of caudal peduncle</td>
</tr>
<tr>
<td>HCPD</td>
<td>Least depth of caudal peduncle</td>
</tr>
<tr>
<td>Bone names</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>--</td>
</tr>
<tr>
<td>ANG</td>
<td>Angular</td>
</tr>
<tr>
<td>BO</td>
<td>Basiooccipital</td>
</tr>
<tr>
<td>DEM</td>
<td>Dentary</td>
</tr>
<tr>
<td>EOP</td>
<td>Ento-pterigoid</td>
</tr>
<tr>
<td>ENT</td>
<td>Ento-pterigoid</td>
</tr>
<tr>
<td>EPO</td>
<td>Epiotic</td>
</tr>
<tr>
<td>EXO</td>
<td>Exoccipital</td>
</tr>
<tr>
<td>FONT</td>
<td>Fontanelle</td>
</tr>
<tr>
<td>FR</td>
<td>Frontal</td>
</tr>
<tr>
<td>HYM</td>
<td>Hyomandibula</td>
</tr>
<tr>
<td>IOP</td>
<td>Interoperculum</td>
</tr>
<tr>
<td>LE</td>
<td>Lateral ethmoids</td>
</tr>
<tr>
<td>MAX</td>
<td>Maxillaries</td>
</tr>
<tr>
<td>MTP</td>
<td>Meta-pterigoid</td>
</tr>
<tr>
<td>ORS</td>
<td>Orbitosphenoide</td>
</tr>
<tr>
<td>OPR</td>
<td>Operculum</td>
</tr>
<tr>
<td>PAL</td>
<td>Palatines</td>
</tr>
<tr>
<td>PLS</td>
<td>Pleurospheonoids</td>
</tr>
<tr>
<td>PMX</td>
<td>Premaxillaries</td>
</tr>
<tr>
<td>PRS</td>
<td>Parasphenoid</td>
</tr>
<tr>
<td>FVM</td>
<td>Vomer</td>
</tr>
<tr>
<td>PRO</td>
<td>Prootic</td>
</tr>
<tr>
<td>PTM</td>
<td>Post-temporal</td>
</tr>
<tr>
<td>PTG</td>
<td>Ento-pterigoid</td>
</tr>
<tr>
<td>Q</td>
<td>Quadrate</td>
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<tr>
<td>SPH</td>
<td>Sphenotics</td>
</tr>
<tr>
<td>SE</td>
<td>Supraethmoid</td>
</tr>
<tr>
<td>SO</td>
<td>Supraoccipital</td>
</tr>
<tr>
<td>SOP</td>
<td>Occipital process</td>
</tr>
<tr>
<td>STM</td>
<td>Supra-temporal</td>
</tr>
<tr>
<td>SCL</td>
<td>Supra-clavicular groove for articulation of pectoral girdle</td>
</tr>
</tbody>
</table>
CLASSIFICATION

Fishes of the family Bagridae were for a long time placed under the Siluridae. Bleeker (1863) realizing the composite nature of the family divided it into eight subfamilies. Bagriformis was created to accommodate ten Stirpes, each of which was further subdivided into Phalanxes. The term Bagrini was used to include genera such as Arius Cuvier & Valenciennes: Gagata Bleeker, Glyptothorax McClelland and others, besides true bagrids such as Rita Bleeker, Leiocassis Bleeker, and Bagroides Bleeker. Günther (1864) adopted the same name, but gave Bagrini the status of a group only. Boulenger (1904a) recognised eight subfamilies under the Siluridae, and group Bagrini was raised for the first time to the rank of a subfamily Bagrinae. Regan (1911) examined the osteological peculiarities of the various siluroid families, and raised the status of Bagrinae to a family rank. Jordan (1923), and Berg (1940) in their classifications did not suggest any division of Bagridae.

Regan (1911) divided the Bagridae into two subfamilies: Chrysichthyinae and Bagrinae, based on the nature of the pterygoid, meso- or ecto-pterygoid inter-digitation and modifications of the fourth vertebra for the support of the air-bladder.
The characters selected by Regan for subdividing the family are of great value, being closely connected with the anterior attachment of the air-bladder. However, examination of the skulls of the most of the genera have now necessitated certain changes in the classification which are discussed below.

Regan (1911) included under the subfamily Bagrinae the following genera: Bagrus Cuvier (= Porcus Geoffroy St. Hilaire), Mystus Scopoli, Leiocassis Bleeker, Bagroides Bleeker and Olyra McClelland. Of these, Olyra has been placed under a separate family Olyridae by Hora (1936a) in view of its having a spineless dorsal fin, and a peculiar type of air-bladder with the associated modifications of the anterior vertebrae. Bagroides along with Bagrichthys Bleeker have now been placed under a new subfamily Bagroidinae. These genera differ from the others in having an enlarged post-temporal plate with a perforation on the anterior face, unlike in Bagrinae and Auchenoglanidinae where it is smaller in size and not perforated. Further, the supraethmoid is longer, the nape is higher, body more robust, mouth smaller with movable labial teeth, than in the genera of other subfamilies. In view of these characters, I have provided a new subfamily rank for Bagroides and Bagrichthys.
Regan (1911) divided the Chrysichthyinae into two groups, based on the shape of the parapophyses of the fourth vertebra. Parauchenoglanis Boulenger, Auchenoglanis Günther, and Notoglanidium Günther have been rightly grouped together, but consideration of these genera under Chrysichthyinae does not portray their importance in distinguishing certain phyletic lines in the evolution of the various bagrid genera. These genera have certain peculiar features unique to themselves. Thus; the subvertebral plate is formed by the fusion of the parapophyses of fifth to eighth vertebrae; the ninth vertebra is the first to bear ribs; the vomer is much reduced; the palatines are comparatively thicker than in other subfamilies and is firmly fixed to the cranium; the lateral ethmoid facet for the articulation of the palatines is more lateral than ventral (Figure 60); the supraoccipital and other otic bones are completely ossified; the entopterygoid is absent and the meso- or ecto-pterygoid is rudimentary. These specialised features justify the provision of a separate subfamily for these genera, and therefore I have proposed Auchenoglanidinae for accommodating them.

The second group under Chrysichthyinae comprises Rita, Pseudobagrus Bleeker, Gephyroglanis Boulenger, Clarotes Kner and Chrysichthys Bleeker.
Rita is unique among the bagrid genera in having seven or eight rays in the pelvic fin and only one pair of mandibular barbels. Although in many osteological features it resembles Chrysichthys, the two characters mentioned now justify the provision of a separate subfamily for Rita. The count of pelvic fin rays was considered as of family importance in certain instances by Myers (1931). Rama has been included along with Rita under Ritinae, provisionally, following Bleeker (1862).

A comparison of certain characters of all the five subfamilies of Bagridae is given in table 1.

SYSTEMATIC ACCOUNT

Phylum CHORDATA
Subphylum CRANIATA
Class OSTEICHTHYES
Subclass TELEOSTOMII
Superorder TELEOSTEICA
Order SILUROIDEA
Family BAGRIDAE

Cranium platytrabic. Either supraethmoid or premaxillaries form the most anterior bone of the cranium. Lateral ethmoids paired and with a facet for the articulation of the palatines. Premaxillaries typically fixed and dentigerous. Maxillaries edentate, reduced forming the basis for maxillary barbel; but in certain African genera
may be large and remain hidden in the lip. Palatines and vomer well developed. Ento-pterigoids rudimentary, or absent, or fused with ento-pterigoid. Meso- or ecto-pterigoid edentate and reduced. Frontals divided along the mid-axis by the fontanelle which may be single or double. Parietals, opisthotic, suboperculum absent. Sphenotics and pterotics small, but distinctively seen. Post-temporal bones narrow, limb-like, with or without an enlarged post-temporal plate at their distal ends. Sphenoid bones normal. Exoccipitals rod-like and sometimes distally expanded. Basioccipital small. Supracleithrum rigidly attached to skull with the lower limb well developed. Mesocoecoid present.

Hyomandibula articulates by a broad head from a groove in the sphenotics and/or in the pterotics. Operculum and interoperculum well developed. Dentary with sensory pores on the ventral surface and joined with its fellow by a ligament. Retroarticular generally fused with angular. Vertebrae 34 to 57, ribs attached to long parapophyses. First four vertebrae united to form the Weberian apparatus.

Body naked. Nostrils two pairs and widely separated. Three or four pairs of barbels. Two dorsal fins, anterior always with a spine and rays, posterior without a spine and smooth (exception Clarotes). Paired and median fins well developed.

Fresh and brackish water fishes of Asia and Africa.
KEY TO THE SUBFAMILIES

1a. Post-temporal bones without any expanded plate. Parapophyses of fourth vertebra decurved both towards anterior and posterior directions.

2a. Vomer a large bone. Pelvic fins with six to eight rays. (India, Burma and China). Ritinae, nov.

2b. Vomer a small bone. Pelvic fins with six rays. (Africa). Chrysoichthynae

1b. Post-temporal bones with an expanded plate. Parapophyses of fourth vertebra decurved only towards the anterior direction.


4a. Vomer a separate bone. Sixth vertebra the first to bear ribs. (China, Siam, Malaya and East Indies). Bagroidinae, nov.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Ritinae, nov.</th>
<th>Chrysichthyinae</th>
<th>Bagrinae</th>
<th>Bagroidinae nov.</th>
<th>Anchomolgandinae, nov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Palatines.</td>
<td>Edentate and loosely connected to the palato-quadrade bar.</td>
<td>May be dentigerous and loosely connected to the palato-quadrade bar.</td>
<td>May be dentigerous and firmly connected to the palato-quadrade bar.</td>
<td>Edentate at the rear of the palato-quadrade bar.</td>
<td>Edentate and firmly connected to the palato-quadrade bar.</td>
</tr>
<tr>
<td>7. Subvertebral plate.</td>
<td>Absent.</td>
<td>Absent.</td>
<td>Absent.</td>
<td>Present, formed by the fusion of the parapophyses of the fifth and six vertebrae.</td>
<td>Present, formed by the fusion of the parapophyses of the fifth to eighth vertebrae.</td>
</tr>
<tr>
<td>8. Vertebrae.</td>
<td>34 to 38.</td>
<td>34 to 56.</td>
<td>45 to 57.</td>
<td>39 to 42.</td>
<td>43 to 48.</td>
</tr>
</tbody>
</table>
Subfamily RITINAE, nov.
(Figures 2 to 5)

Cranium broader than long and completely ossified. Back of cranium moderately excavated and not flat. Lateral ethmoid facet for the articulation of the palatines more ventral than lateral. Palatines edentate and loosely connected to the palato-quadrate bar. Maxillaries reduced. Vomer a single, large dentigerous bone. Ento-pterygoid fused with meso- or ecto-pterygoid; latter fused with vomer and thus loosely connected to the palato-quadrate bar. When disarticulated ecto-pterygoid remains with vomer. Post-temporal bones without any expanded plate. Supracleithrum articulating from a groove formed by the exoccipitals and post-temporal bones. Exoccipitals not modified into any cup-like structure at their distal ends. Parapophyses of fourth vertebra decurved towards anterior and posterior directions respectively and not fused with each other at the base. The anterior wall of the air-bladder is excluded from contact the post-temporal bones by this anterior division of the parapophyses of fourth vertebra. Fifth vertebra rigidly united with the sixth. Vertebrae 34 to 38.

Nostils modified; anterior pair funnel-shaped, and the posterior with a valve-like base provided by the nasal barbels. Pelvic fins with six to eight rays. Air-bladder large, free, thick-walled with an internal median longitudinal septum and an anterior transverse septum. Lateral or posterior oesophagus may be present.
KEY TO THE GENERA

1a. Nasal barbels present. Outer mandibular pair of barbels absent. Pelvic fins with seven or eight rays.

Rita


Rama

Genus RITA Bleeker


Body short and compressed. Dorsal profile arched.

Head large and depressed. Snout obtusely pointed, but not produced. Jaws subequal. Lips thin and plain, occasionally fimbriate. Mouth subterminal and moderately wide. Villiform teeth on premaxillaries and mandibular in bands; that on former not produced laterally, that on latter produced laterally, but with rounded ends, separated at the centre by an edentate space and mixed with molariform teeth also; only molariform teeth on vomer. Eyes small, supralateral and in anterior part of head. Supraccipital covered with skin or not covered and with a backward extending process. Three pairs of barbels: one maxillary, one mandibular and one nasal; latter with a valve-like base, minute and hardly developed.
Gill membranes free from each other along postero-lateral borders only, but completely free from isthmus. Branchiostegals eight.

Origin of rayed dorsal fin above half pectoral fin; with six or seven rays and a spine. Adipose dorsal fin short, low, smooth and with the posterior margin free. Pectoral fins horizontally inserted and with a spine. Pelvic fins inserted on ventral surface below third ray of dorsal fin. Anal fin with eight to 13 rays. Caudal fin deeply forked. Lateral line with well developed scutes along first quarter, rather uniformly distinguishable in all species.

3½ to 38 vertebrae, 18 to 20 precaudal and 16 to 18 caudal.

DISTRIBUTION.— India, Pakistan, Burma and China (Yunnan).

The southern limit in India is the Krishna River system.

KEY TO THE SPECIES

1a. Teeth on palate in a single patch.

2a. Diameter of eye 2.83 to 5.22 in head length. chrysea

2b. Diameter of eye 5.25 to 8.28 in head length. poga

1b. Teeth on palate in a double patch.

3a. Teeth on palate in pear-shaped patches (Figure 9). kuturnee

3b. Teeth on palate in elliptical patches (Figure 12). rita
RITA CHRYSEA Day
(Figure 6)


SPECIMENS STUDIED.- ZSI Cat. 498, 'Orissa', Sept. 12, 1878, purchased from F. Day, original of pl. civ, fig. 1 in The Fishes of India, one specimen (holotype), 103 mm.

ZSI (Not numbered), Anicut, River Mahanadi, Cuttack, T. Southwell coll., one specimen, 94 mm.

ZSI F. 736/2, Kundal Dhar, River Tel, Belgaon, Mar. 19, 1946, B. S. Chauhan coll., 12 specimens, 56 to 154 mm.

ZSI F. 812/2, Anicut, River Mahanadi, Cuttack, Oct. 18 to 20, 1954, K. C. Jayaram coll., 126 specimens (topotypes), 78 to 167 mm.


ZSI F. 814/2, Chandarpur, River Mahanadi, Nov. 17, 1954, K. C. Jayaram coll., 50 specimens, 50.2 to 90.8 mm.

ZSI F. 815/2, Sambalpur fish market, Sambalpur, Nov. 11, 1954, K. C. Jayaram coll., 22 specimens, 38 to 128 mm.

DESCRIPTION.- Body depth 4.40 (3.59 to 5.61); head length 3.60 (2.80 to 3.84); head width 5.72 (4.00 to 7.41); head depth 5.52 (4.47 to 6.51); predorsal length 2.49 (2.27 to 2.91) (N = 30); postdorsal length 1.65 (1.50 to 1.76)(N = 30); prepelvic distance 1.77 (1.66 to 1.87) (N = 30); length of longest ray of caudal fin 3.83 (2.24 to 4.97) (N = 30), all in standard length. Eye 3.76 (2.83 to 5.22) in head length; 1.30 (1.00 to 2.13) in interorbital space width; 1.44 (1.07 to 2.13) in snout length. Dorsal spine
2.83 (2.19 to 5.06); pectoral spine 1.12 (0.97 to 1.39) (N = 30) in head length. Adipose dorsal fin base 1.83 (1.65 to 2.00) in anal fin base. Least depth of caudal peduncle 1.64 (1.24 to 2.21) in its length.

Dorsal profile of head at an angle of 20 to 25 degrees to main body axis. Occipital process subcutaneous, 1.0 or 2.0 times longer than width at its base, and extending to the predorsal plate. Premaxillary band of teeth 1.0 or 1.5 times as long as broad. Mandibular band of teeth molariform and villiform; the former of different sizes and placed towards inner margin, latter of uniform size and placed towards outer margin. Teeth on palate not of uniform size, confined to vomer and in a single undivided semioval patch (Figure 6). Maxillary barbels reaching pectoral fin base; others shorter. Orbital rims free. Longest ray of dorsal fin not extending to adipose fin when depressed. Dorsal spine with feeble teeth over posterior margin, occasionally over anterior margin also. Pectoral spine with 15 to 20 strong, antrorsce teeth over posterior margin, and 10 to 15 retrorsce teeth over anterior margin. Cheithral processes equal to pectoral spine length. Pelvic fin not reaching anal fin origin. Longest anal ray not extending to caudal fin. Lateral line slightly arched above pectoral fin.

Proportional measurements, not given in the description, are recorded in table 25, and counts in table 26.

COLOUR.—Golden or creamy-yellow above and on sides, whitish-yellow beneath. Live specimens are of lead-grey colour, above
and on sides, white beneath. Orbital rims bright yellowish. Some specimens have a violet tint on and near the occipital region. Specimens from Sambalpur and Chandarpur are with wavy, alternating white and grey vertical bands on the sides; the bright-yellow tint is only near the crown of the occiput. 

RELATIONSHIP.— This species is related to R. kuturnee differing in having smaller eye, shorter dorsal spine and in the pattern of dentition and colouration.

DISTRIBUTION.— Belgaon, Chandarpur, Cuttack, River Mahanadi, Orissa, Sambalpur, River Tel; India. Mainly confined to the River Mahanadi and its affluents.

TYPE LOCALITY.— Day (1877: 455) described R. chrysea from a single specimen from "Orissa". The holotype is preserved in the Zoological Survey of India (ZSI Cat. 498) and is labelled as purchased from F. Day on Sept. 12, 1878. Southwell collected a second specimen of the species from the River Mahanadi, Anicut, Cuttack. Chauhan (1947: 276) collected 12 specimens of the species from the River Tel at Belgaon, Bolangir district, Orissa State. During a field trip in Oct.-Nov. 1954, I collected 343 specimens of this species from Cuttack (near the Anicut), Sambalpur and Chandarpur on the River Mahanadi. Comparison of Day's specimen, the holotype from "Orissa", with those from other localities indicates its agreement with the population inhabiting Cuttack rather than with others. Therefore, in the light of suggestions of Smith (1953) for revision of type localities, I designate Anicut, River Mahanadi, Cuttack as the type locality of R. chrysea.
LOCAL RACES.

Description of the environments.— The River Mahanadi is the largest river in the Orissa State with a total length of 533 miles. It rises in the Sihawa Hills to the extreme south-west of Raipur district of Madhya Pradesh at an elevation of about 2, 200 ft. It is entirely rain-fed and hence 80% of the total run-off occurs during the monsoon, between June and October. The river course in Sambalpur district is surrounded by an undulating hilly terrain, unlike at Chandarpur, situated at a distance of about 60 miles north-west to Sambalpur, where the river flows through alluvial soil. At Sambalpur, the Mahanadi has a bed width of over one mile whereas at Chandarpur it is less than half a mile. The region below Sambalpur is not thickly populated, till Cuttack about 250 miles south-east to Sambalpur (after Job, David & Das, 1955). The river is dammed at Hirakud, nine miles above the town of Sambalpur, besides at Tikarpara and Naraj, 130 and 200 miles respectively below Hirakud. The river bed at Cuttack is more than a mile in width. The Anicut at Cuttack is a long temporary road bridge used only in the dry months of the year when the water level in the river is low.

Statement of the problem.— In view of the different types of environments found at Sambalpur, Chandarpur and Cuttack three samples were collected from these places (see below, also Figure 8) for a statistical study of R. ahryae.—

Sample A. River Mahanadi, Anicut, Cuttack (Figure 7) N = 126  
B. River Mahanadi, Kamli Bazaar, Sambalpur N = 167  
C. River Mahanadi, Chandarpur N = 50
The study was undertaken to test (i) whether the stock in the River Mahanadi is homogenous, (ii), if not to determine the population which diverged most, (iii) to find whether the three populations of which samples were collected are different from each other, and (iv) to find whether they are taxonomically divergent to be named as separate infra-specific categories.

Possible solution.— A preliminary study (tables 2 to 10) was carried out employing the method of analysis of covariance which revealed possible populational divergence. In order to determine whether the typical population at Cuttack (A diverged most, it was compared (table 11, graphs 1 to 15) with all the remaining populations pooled together (X), employing the t test. Ginsburg's method (1938, 1939, 1940) of computing intergradation and divergence was applied to these populations A and X. The results are as below.—

<table>
<thead>
<tr>
<th></th>
<th>In percent</th>
<th>Divergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL/Body depth</td>
<td>35.12</td>
<td>64.88</td>
</tr>
<tr>
<td>SL/Head width</td>
<td>29.49</td>
<td>70.51</td>
</tr>
<tr>
<td>SL/Head depth</td>
<td>37.28</td>
<td>62.72</td>
</tr>
<tr>
<td>SL/Length of dorsal spine</td>
<td>31.07</td>
<td>68.93</td>
</tr>
<tr>
<td>LH/Snout</td>
<td>33.32</td>
<td>66.68</td>
</tr>
<tr>
<td>LH/Eye</td>
<td>31.35</td>
<td>68.65</td>
</tr>
<tr>
<td>LH/Width of gape of mouth</td>
<td>38.74</td>
<td>61.26</td>
</tr>
<tr>
<td>LOPD/EGFD</td>
<td>16.89</td>
<td>83.11</td>
</tr>
<tr>
<td>LH/EGFD</td>
<td>7.93</td>
<td>92.07</td>
</tr>
</tbody>
</table>
The analysis indicates that the populations have diverged to the subspecific or specific levels in respect to characters such as the length and depth of caudal peduncle.

Having thus established that the typical population is divergent to the maximum extent from all the other populations pooled together, the Sambalpur population (B) was compared with the population at Cuttack (A) to determine whether it is statistically different when considered alone. The data of this study are summarized in table 12 and certain variations delineated in graphs 16 to 26.

A third comparison was made to determine whether the Chandarpur population (C) is statistically different from the Sambalpur population (B). The data of this study are summarized in table 13 and certain variations delineated in graphs 27 to 29.

**Conclusions.** As a result of these studies, I conclude that (i) the stock of *R. chrysëa* in the River Mahanadi is heterogenous, (ii) the population at Cuttack diverges most, and (iii) the populations at Sambalpur, Chandarpur are statistically different from each other.

The characters which show the divergence among these populations best are the relative length and depth of the caudal peduncle. Although the divergence approaches a high level of differentiation if Ginsburg's method of designating populations is used, I refrain from naming them since these differences are purely statistical and may not represent real, biological differences to separate them taxonomically. Further, the possibility of geographical gradients among the characters selected in the various populations is also not eliminated. As such, I tentatively consider these populations as *Racémus*.
### TABLE 2. - COMPARISON OF THE REGRESSIONS OF THE TOTAL LENGTH
OF FOUR SAMPLES OF RITA CHRYSEA POPULATION FROM RIVER KAMANADI.

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>148</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-\bar{x})^2$</td>
<td>32394.80</td>
<td>70323.30</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2$</td>
<td>49690.85</td>
<td>105186</td>
<td>19892</td>
<td>17322.33</td>
</tr>
<tr>
<td>$S(x-\bar{x})(y-\bar{y})$</td>
<td>38930.72</td>
<td>85257.95</td>
<td>15518.65</td>
<td>13637</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>1.202</td>
<td>1.212</td>
<td>1.276</td>
<td>1.253</td>
</tr>
<tr>
<td>$b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>46794.73</td>
<td>10332.64</td>
<td>19802</td>
<td>17087</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2 - b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>28961.12</td>
<td>1853</td>
<td>90</td>
<td>235</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D. F.</th>
<th>S. C.</th>
<th>Mean sum of Squares</th>
<th>Obs. $F.$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>333</td>
<td>5074</td>
<td>15.24</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>335</td>
<td>5401</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation</td>
<td>2</td>
<td>327</td>
<td>163.5</td>
<td>10.73</td>
</tr>
</tbody>
</table>

D. F. = Degrees of Freedom  
$x$ = Standard length  
$y$ = Mean of values of $y$  
$Y$ = The variable  
$X$ = Mean of values of $x$  
Obs. $F.$ = Observed  
$b_{yx}$ = Regression Coefficient  
$\bar{y}$ = Mean of values of $y$  
$S$ = Summation
TABLE 3.- COMPARISON OF THE REGRESSIONS OF THE LENGTH OF
HEAD OF FOUR SAMPLES OF RITA CHRYSAEA POPULATION FROM
RIVER MAHANADI.

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-\bar{x})^2$</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2$</td>
<td>3016.12</td>
<td>5779.37</td>
<td>1029</td>
<td>923.6</td>
</tr>
<tr>
<td>$S(x-\bar{x})(y-\bar{y})$</td>
<td>9250.03</td>
<td>20603.36</td>
<td>3473</td>
<td>3129.76</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>0.2855</td>
<td>0.2771</td>
<td>0.2854</td>
<td>0.2878</td>
</tr>
<tr>
<td>$b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>2640.88</td>
<td>5709.19</td>
<td>991.19</td>
<td>900.74</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2 - b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>375.34</td>
<td>70.18</td>
<td>38</td>
<td>22.36</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D. F.</th>
<th>S. C.</th>
<th>Mean sum of Squares</th>
<th>Obs. 1 % F. F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>468.76</td>
<td>1.335</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>353</td>
<td>519.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation</td>
<td>2</td>
<td>50.77</td>
<td>25.385</td>
<td>19.015 4.66</td>
</tr>
</tbody>
</table>
TABLE 4.- COMPARISON OF THE REGRESSIONS OF THE DEPTH OF BODY OF FOUR SAMPLES OF *ALTA CHRYSEA* FROM RIVER MAHANADI

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. f.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-\bar{x})^2$</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2$</td>
<td>2186.23</td>
<td>5580.56</td>
<td>857</td>
<td>813.71</td>
</tr>
<tr>
<td>$S(x-\bar{x})(y-\bar{y})$</td>
<td>7489.95</td>
<td>20120.8</td>
<td>3202.45</td>
<td>2933.20</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>0.2312</td>
<td>0.2706</td>
<td>0.2632</td>
<td>0.2697</td>
</tr>
<tr>
<td>$b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>1731.68</td>
<td>5444.69</td>
<td>842.88</td>
<td>791.08</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2 - b_{yx}S(x-\bar{x})$</td>
<td>454.55</td>
<td>135.87</td>
<td>14.12</td>
<td>22.63</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D. F.</th>
<th>S. S. of Squares</th>
<th>Mean sum</th>
<th>Obs. 1 % F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>627.17</td>
<td>1.787</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>353</td>
<td>862.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation</td>
<td>2</td>
<td>235.29</td>
<td>117.64</td>
<td>65.83</td>
</tr>
</tbody>
</table>
TABLE 5. - COMPARISON OF THE REGRESSIONS OF THE LENGTH OF SNOUT OF FOUR SAMPLES OF RITA CHRYSEA FROM RIVER KAHANADI.

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-x)^2$</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-y)^2$</td>
<td>482.239</td>
<td>691.691</td>
<td>116.77</td>
<td>111.67</td>
</tr>
<tr>
<td>$S(x-x)(y-y)$</td>
<td>3639.700</td>
<td>7025.10</td>
<td>1169.88</td>
<td>1018.02</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>0.1124</td>
<td>0.0945</td>
<td>0.0962</td>
<td>0.0936</td>
</tr>
<tr>
<td>$b_{yx}S(x-x)(y-y)$</td>
<td>409.102</td>
<td>663.872</td>
<td>112.54</td>
<td>95.29</td>
</tr>
<tr>
<td>$S(y-y)^2 - b_{yx}S(x-x)(y-y)$</td>
<td>73.137</td>
<td>27.819</td>
<td>4.23</td>
<td>16.38</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D.F.</th>
<th>S. S.</th>
<th>Mean sum of Squares</th>
<th>Obs. F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>121.57</td>
<td>0.3464</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>353</td>
<td>129.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviation</td>
<td>2</td>
<td>7.585</td>
<td>3.793</td>
<td>10.95</td>
</tr>
</tbody>
</table>
TABLE 7. - COMPARISON OF THE REGRESSIONS OF THE INTERORBITAL SPACE WIDTH OF FOUR SAMPLES OF RITA CHRYSEA FROM RIVER MAHANADI.

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-x)^2$</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-y)^2$</td>
<td>642.96</td>
<td>912.418</td>
<td>168</td>
<td>95.48</td>
</tr>
<tr>
<td>$S(x-x)(y-y)$</td>
<td>4309.62</td>
<td>7807.39</td>
<td>1340.85</td>
<td>887.86</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>0.133</td>
<td>0.105</td>
<td>0.110</td>
<td>0.0816</td>
</tr>
<tr>
<td>$b_{yx}S(x-x)(y-y)$</td>
<td>573.18</td>
<td>819.78</td>
<td>147.49</td>
<td>72.45</td>
</tr>
<tr>
<td>$S(y-y)^2 - b_{yx}S(x-x)$</td>
<td>69.78</td>
<td>92.64</td>
<td>20.51</td>
<td>23.03</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D.F.</th>
<th>S. C. Mean sum of Squares</th>
<th>Obs. F.</th>
<th>1 % F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>205.96</td>
<td>0.5868</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>353</td>
<td>301.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Deviation | 2    | 95.04 | 47.52 | 80.98 | 4.66 |
TABLE 8. - COMPARISON OF THE REGRESSIONS OF THE LENGTH OF DORSAL SPINE OF FOUR SAMPLES OF RITA CARYSEA FROM RIVER MAHARADI.

<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>( S(x-x)^2 )</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>( S(y-y)^2 )</td>
<td>4911.48</td>
<td>11321.50</td>
<td>1106.56</td>
<td>2093.38</td>
</tr>
<tr>
<td>( S(x-x)(y-y) )</td>
<td>11161.55</td>
<td>28509.87</td>
<td>3169.53</td>
<td>4722.51</td>
</tr>
<tr>
<td>( b_{yx} )</td>
<td>0.3445</td>
<td>0.3835</td>
<td>0.2605</td>
<td>0.4338</td>
</tr>
<tr>
<td>( b_{yx}S(x-x)(y-y) )</td>
<td>384515</td>
<td>10933.54</td>
<td>825.77</td>
<td>2048.62</td>
</tr>
<tr>
<td>( S(y-y)^2 - b_{yx}S(x-x) ) ( (y-y) )</td>
<td>1066.33</td>
<td>387.96</td>
<td>280.79</td>
<td>44.76</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D. F.</th>
<th>S. S.</th>
<th>Mean sum of squares</th>
<th>Obs. F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>1779.84</td>
<td>4.929</td>
<td></td>
</tr>
<tr>
<td>Common Regression</td>
<td>353</td>
<td>2109.31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Deviation

<p>| Deviation | 2 | 329.47 | 164.73 | 33.42 | 4.66 |</p>
<table>
<thead>
<tr>
<th>Samples</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. F.</td>
<td>125</td>
<td>166</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>$S(x-\bar{x})^2$</td>
<td>32394.80</td>
<td>74342.18</td>
<td>12167</td>
<td>10874.76</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2$</td>
<td>808.674</td>
<td>2129.737</td>
<td>423</td>
<td>352.48</td>
</tr>
<tr>
<td>$S(x-\bar{x}) (y-\bar{y})$</td>
<td>4711.60</td>
<td>12379.009</td>
<td>2200.72</td>
<td>1895.770</td>
</tr>
<tr>
<td>$b_{yx}$</td>
<td>0.1454</td>
<td>0.1665</td>
<td>0.181</td>
<td>0.1742</td>
</tr>
<tr>
<td>$b_{yx}s(x-\bar{x}) (y-\bar{y})$</td>
<td>685.07</td>
<td>2061.104</td>
<td>398.33</td>
<td>330.24</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2 - b_{yx}s(x-\bar{x}) (y-\bar{y})$</td>
<td>128.604</td>
<td>68.633</td>
<td>24.67</td>
<td>22.24</td>
</tr>
</tbody>
</table>

Test of heterogeneity of regressions within the population

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D. F.</th>
<th>S. S.</th>
<th>Mean sum of Squares</th>
<th>Obs. F.</th>
<th>1 % F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Regression</td>
<td>351</td>
<td>239.147</td>
<td>0.681</td>
<td></td>
<td></td>
</tr>
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TABLE 10.- COMPARISON OF THE REGRESSIONS OF THE ANAL FIN RAYS COUNT OF FOUR SAMPLES OF RITA CRYSTALL FROM RIVER MAHANADI.

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<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<td>166</td>
<td>11</td>
<td>49</td>
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<td>152.55</td>
<td>17.6</td>
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</tr>
<tr>
<td>$S(x-\bar{x})(y-\bar{y})$</td>
<td>943.15</td>
<td>2609.82</td>
<td>374.20</td>
<td>623.344</td>
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<td>0.0351</td>
<td>0.0308</td>
<td>0.0573</td>
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<td>$b_{yx}S(x-\bar{x})(y-\bar{y})$</td>
<td>27.466</td>
<td>91.60</td>
<td>11.53</td>
<td>35.72</td>
</tr>
<tr>
<td>$S(y-\bar{y})^2 - b_{yx}S(x-\bar{x})$</td>
<td>82.19</td>
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<td>15.90</td>
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Test of heterogeneity of regressions within the population

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<th>Mean sum of squares</th>
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TABLE 11. - BIOOMETRIC COMPARISON OF TWO SAMPLES OF RITA JERUSALEM.

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<th>( t_{0.05} )</th>
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<td>A</td>
<td>126</td>
<td>3.79 to 5.61</td>
<td>4.56</td>
<td>0.398</td>
<td>0.035</td>
<td>6.10</td>
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<td>0.209</td>
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<td>0.009</td>
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<td>0.01</td>
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<td>Dorsal fin rays</td>
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<td>0.501</td>
<td>0.045</td>
<td>Less than</td>
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### TABLE 13.- BIOMETRIC COMPARISON OF TWO SAMPLES OF RITA CHRYSEA.

Sample (B) from Sambalpur  |  Sample (C) from Chandarpur

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<th>Characters</th>
<th>Samples</th>
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<th>Mean</th>
<th>$\sigma$</th>
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<th>$t$</th>
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<tr>
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<td>B</td>
<td>167</td>
<td>3.59 to 5.03</td>
<td>4.35</td>
<td>0.285</td>
<td>0.022</td>
<td>0.62</td>
<td>Greater than 0.10</td>
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<td>C</td>
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<td>SL/Head length</td>
<td>B</td>
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<td>0.289</td>
<td>0.022</td>
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<td>1.41</td>
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</table>
RITA KUTURNEE (Sykes) ¹

(Figure 9)


Arius hastatus Cuvier & Valenciennes, Histoire naturelle des poissons, XV, p. 97, fig. 1, 1840 (type locality, not cited).


SPECIMENS STUDIED. — ZSI Cat. 238, Mandalay, Burma, F. Day coll., one specimen, 222 mm.

ZSI Cat. 239, Mandalay, Burma, F. Day coll., one specimen, 194 mm.

ZSI Cat. 240, Mandalay, Burma, F. Day coll., one specimen, 185 mm.

ZSI Dup. Cat. 318, Burma, F. Day coll., one specimen, 318 mm.

ZSI F. 802/2, Poona, River Mutha Mula, four specimens, 82.2 to 97.0 mm.

ZSI 1082, Poona, River Mutha Mula, purchased F. Day, one specimen, 95 mm.

¹ The priority of Sykes' names have been overlooked by many workers. Sykes' work was published in May 1839, whereas Cuvier & Valenciennes' was published in Nov. 1840.
ZSI 9109, River Weinganga, Chanda, W. J. Blanford coll., three specimens, 71 to 96 mm.

ZSI (Not numbered), River Tungabhadra, Kurnool, Feb. 10, 1955, K. C. Jayaram coll., 176 specimens, 35 to 103 mm.

ZSI (Not numbered), purchased from fish market, Kurnool, Feb. 12, 1955, K. C. Jayaram coll., 12 specimens, 40.5 to 87.0 mm.

ZSI (Not numbered), Itwara market, Nanded, Jan. 24, 1955, K. C. Jayaram coll., one specimen, 70 mm.

ZSI (Not numbered), River Manjra above Nizamsagar dam at Gellli Lingal village, Nagareddy taluq, Jan. 29, 1955, K. C. Jayaram coll., five specimens, 36.0 to 98.5 mm.

ZSI (Not numbered), River Manjra, below Road bridge near Nizamsagar dam, Nizamsagar, Jan. 29, 1955, K. C. Jayaram coll., two specimens, 70.0 and 71.0 mm.

DESCRIPTION.— Body depth 4.81 (3.70 to 6.56); head length 3.31 (2.28 to 3.69); head width 4.91 (4.00 to 6.73); head depth 5.91 (4.07 to 7.25); predorsal length 2.38 (2.11 to 2.54) (N = 30); postdorsal length 1.70 (1.62 to 1.81) (N = 30); prepelvic distance 1.76 (1.63 to 1.85) (N = 30); length of longest ray of caudal fin 3.74 (3.17 to 4.38) (N = 25), all in standard length. Eye 3.07 (2.70 to 4.70 or upto 8.80 in specimens from Burma) in head length; 1.35 (1.00 to 1.50 or 3.90) in interorbital space width; 1.69 (1.00 to 1.50 or 3.00) in snout length. Dorsal spine 3.28 (2.82 to 4.46) (N = 176); pectoral spine 1.15 (0.96 to 1.50) (N = 30) in head length. Adipose dorsal fin base 1.23 (1.00 to 1.50) in anal fin base. Least depth of caudal peduncle 1.73 (1.00 to 2.54) in its length.
Dorsal profile of head at an angle of about 50 degrees to main body axis. Occipital process subcutaneous, 1.5 or 2.0 times longer than width at its base and extending to the predorsal plate. Premaxillary band of teeth 5.0 or 6.0 times as long as broad. Mandibular band of teeth molariform and villiform; the former nearly of uniform size and placed towards inner margin, latter of uniform size and placed towards outer margin. Teeth on palate of uniform size, confined to vomer and in pear-shaped patches, nearly separate but for an anterior union (Figure 9). Maxillary barbels reaching pectoral fin base; others shorter. Orbital rims partly free along lower margins. Longest ray of dorsal fin not extending to adipose fin when depressed. Dorsal spine with feeble teeth over posterior margin, rough over anterior margin also. Pectoral spine with 14 to 19 strong, anterose teeth over posterior margin, with 15 to 22 retrorse teeth over anterior margin. Cheithral processes three-fourth pectoral spine length. Pelvic fin not reaching anal fin origin. Longest anal ray not extending to caudal fin. Lateral line nearly straight.

Proportional measurements, not given in the description, are recorded in table 25, and counts in table 26.

COLOUR.—Light brown above and on sides, pale white beneath. Live specimens are cement-grey or light ashy-grey above, silvery white on sides below, lateral line and beneath. The orbit is tinged yellow.

RELATIONSHIP.—This species is related to R. chrysea differing in having larger eye, longer dorsal spine and in the pattern of dentition and colouration.

LOCAL RACES.-

Description of the environments.- The River Manjra is a tributary to the Godavari joining its right bank near Nanded and running for a total length of 387 miles across the Deccan. It is dammed near Nizam-sagar town, 100 miles from Hyderabad. Below the dam the river bed is about 200 yards wide, and is rocky. But, at Golli Lingal village which is above the dam, the river is a small stream of 100 yards width, and with sandy bed.

The River Tungabhadra is formed by the union of two rivers: the Tunga and Bhadra which arise together in the Western Ghats at Gangamula, on the frontier of Kadur district, Mysore State. The Tungabhadra after running a total length of 400 miles joins the Krishna River at Sangam village near Kurnool, which itself is 151 miles from Hyderabad. The river is dammed at Sunkemula, 12 miles from Kurnool. At Kurnool, the river is about 300 yards wide, with sandy alluvial bed. At Sangam, the river is a mile wide with sandy bed.

The Mutha Mula River is formed by the union of two small rivers: the Mutha and Mula rising from the Western Ghats. Near Poona, the river is hardly 100 yards wide, with a rocky bed. The River Wainganga is a tributary to the River Godavari joining it near Sirpur, Andhra Pradesh.
Statement of the problem.— Five samples (see below, also Figure 11) of R. kuturnee were available for a statistical analysis.—

Sample A. River Tungabhadra, Kurnool  \( N = 176 \)

B. River Manjra, Golli Lingal village  \( N = 5 \)

C. River Wainganga, Chanda  \( N = 3 \)

D. River Mutha Mula, Poona  \( N = 5 \)

E. River Irrawaddy, Burma  \( N = 4 \)

The study was undertaken to test whether the populations in Rivers Manjra, Wainganga, Mutha Mula and Irrawaddy are statistically different from each other. No comparisons of these populations with the population in the River Tungabhadra was made in view of the difference in the size of the material.

Possible solution.— Preliminary inspection of the morphometric characters (table 25) revealed possible populational divergence between the populations. Therefore, to test this further the \( t \) test was employed using selected characters. The data are summarized in tables 14 to 19, and certain variations delineated in graphs 30 to 33.

Conclusions.— As a result of the study, I conclude that the population in the River Irrawaddy, Burma is distinct and separable from the others by its eye size. However, I refrain from naming it in view of the small, unrepresentative nature of the sample. All the other populations do not differ statistically from each other.
### TABLE 14. - BIOMETRIC COMPARISON OF TWO SAMPLES OF RITA KUTURNEE.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Samples</th>
<th>N</th>
<th>Range</th>
<th>Mean</th>
<th>σ</th>
<th>±σn</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH/Snout</td>
<td>B</td>
<td>5</td>
<td>2.27 to 2.50</td>
<td>2.39</td>
<td>0.107</td>
<td>0.048</td>
<td>3.58</td>
<td>Less than</td>
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<td>C</td>
<td>3</td>
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<td>0.101</td>
<td>3.58</td>
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<td>B</td>
<td>5</td>
<td>2.92 to 3.53</td>
<td>3.28</td>
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<td>0.141</td>
<td>0.62</td>
<td>Greater than</td>
</tr>
<tr>
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<td>LH/LCPD</td>
<td>B</td>
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<td>0.082</td>
<td>5.14</td>
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<td>0.59</td>
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<td>C</td>
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<td>Snout/Eye</td>
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<td>1.25 to 1.50</td>
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<td>0.083</td>
<td>1.15</td>
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### TABLE 15. - BIOMETRIC COMPARISON OF TWO SAMPLES OF RITA KUTURNEE.

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<th>Characters</th>
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<th>N</th>
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<th>Mean</th>
<th>σ</th>
<th>±σn</th>
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<td>2.39</td>
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<td>0.141</td>
<td>0.95</td>
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<td>1.37</td>
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<td>0.083</td>
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<tr>
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<td>0.049</td>
<td>0.52</td>
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<td>Mean</td>
<td>σ−</td>
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Phraetocephalus gogra Sykes, Trans. zool. Soc. Lond., II, p. 574, pl. lxvi, fig. 1, May 1859 (type locality, River Bhima, "Seedataik").

Arius pavimentatus Cuvier & Valenciennes, Histoire naturelle des poissons, XV, p. 94, 1840 (River Gange).


SPECIMENS STUDIED.—ZSI 1200, Kurnool, purchased F. Day, one specimen, 120 mm.

ZSI (Not numbered), purchased at Sandia Hat, Harda fish market, Koshangabad district, Feb. 28, 1941, Hara & Huir coll., three specimens, 125 to 129 mm.

ZSI (Not numbered), purchased from fish market, Nanded, Jan. 23, 1955, K. C. Jayaram coll., twelve specimens, 116 to 224 mm.

ZSI (Not numbered), River Manjra above Hisamsagar dam at Golli Lingal village, Nagarreddy taluq, Jan. 28, 1955, K. C. Jayaram coll., 13 specimens, 145 to 262 mm.

ZSI (Not numbered), River Manjra below road bridge, Hisamsagar dam, Hisamsagar, Jan. 29, 1955, K. C. Jayaram coll., three specimens, 155 to 183 mm.

ZSI (Not numbered), purchased from Hastaguth fish market, Poona, Feb. 15, 1955, K. C. Jayaram coll., three specimens, 163 to 217 mm.