ator from which the gases therein manufactured are led away in pipes to the heating-place. The generator, *i. e.* the HOLLAND retort is at the heating-place, in the fire-box of the locomotive, and the full effect of the carbon combustion is therefore obtained in both cases, whether the dissociation of the steam takes place to furnish oxygen for the first stage of this combustion only or whether the dissociation is accomplished so as to burn up the carbon completely with oxygen derived from the dissociated water-vapor. But there is this great difference: If the carbon derives all the oxygen necessary for its complete conversion into carbonic acid from the dissociation of the steam, there will be twice as much hydrogen liberated as against its conversion into carbonic oxide only, as will be seen from the following statement of the two cases by DAHLERUS:

"When watery vapor burns carbon to carbonic oxide, there are formed from two volumes of watery vapor and one volume of carbon two volumes of carbonic oxide and two volumes of hydrogen; further, when carbon is burned by watery vapor to carbonic acid, there are formed from one volume of carbon and four volumes of watery vapor, two volumes of carbonic acid and four volumes of hydrogen. Consequently the volume of hydrogen in the gases is equal to the volume of carbonic oxide and double that of the volume of carbonic acid."

In connection with these important relations I must, in conclusion, refer to the results of numerous experiments, made with the HOLLAND process, which can only be fully and satisfactorily explained in the light of the previous discussion. They are certainly a most remarkable series of experiments, never before equalled or excelled; the results accomplished by the Naphtha and water process have startled all experts and scientists who have witnessed them, while those who have not seen their actual performance reluctantly admit their genuineness. Yet they are absolute facts, and the possibilities which they have in store are greater than anything that has as yet been reported.

In starting the fire under the boiler of this locomotive, it must be stated, there is first lighted a small tank filled with naphtha, which is placed under one of the retorts in the fire-box. As soon as this retort is thereby sufficiently heated to gasify the naphtha, naphtha-gas is burned under all the retorts, and water admitted into them to be converted into steam. When both naphtha and water are thus gasified, their gases are jointly admitted to all the burners under the whole length of the boiler, and the generation of steam now begins in earnest. As soon as feasible, steam from the boiler is introduced into the retorts instead of water, so that after th's period the naphtha only has to be gasified in the retorts.

I now give one of Mr. CONANT'S tables in full, containing the results of an experiment he witnessed on April 29th:

LIGHTED AT 10:05 A. M. GAS STARTED AT 10:35.

Steam, Pounds.	Time, M.	Naptha, Gall.	Naptha, Per Lb. Gall.	Naptha, Per Min Gall.	Totals. Gall.	Totals. H. M.
10	69½	5.62	.56	.08	5.62	1 09½
20	15	3.83	.40	.27	9.45	1 24½
30	18½	2.7	.29	.15	12.35	1 43
40	9	2.41	.24	.27	14.76	1 52
50	8	2.14	.21	.27	16.9	2 00
60	7	2.14	.21	.30	19.04	2 07
70	5	1.61	.16	.32	20.65	2 12
80	3½	1.07	.10	.30	21.72	2 15½
90	4½	1.07	.10	.24	22.79	2 20
100	4	1.07	.10	.27	23.86	2 24
110	4	1.07	.10	.27	24.93	2 28
120	4	1.07	.10	.27	26.00	2 32
Engine started out—safety valve blowing—oil disturbed and no record.						
133	5	----	----	----	----	----

Pop valve blowing av. 33 sec., with 32 sec. intervals. No right of way and no run.

The puzzling fact that the higher the temperature and the steam-pressure rise, the less naphtha is burned, would be absolutely inexplicable if it was not for the relations alluded to in the foregoing observations. Up to 60 or 70 pounds of steam-pressure in the boiler the consumption of naphtha averages 2.14 gals. for every ten pounds of pressure added, while above these figures, it averages only 1.07 gals.—just one-half of the former quantity—for every additional 10 pounds. We know what that means. It means that there is an evident supplanting of the naphtha by some other much more powerful heating agent; the naphtha in this process unmistakably plays a subordinate role, as far as the heating is concerned. We know its task. It dissociates the water and thereby liberates its hydrogen; it is the latter that furnishes the bulk of the caloric energy developed. During the earlier stages, when the steam-pressure is yet comparatively low, the quantity of steam introduced into the retorts is limited and the carbon therefore is burned up to carbonic oxide only by dissociated oxygen; as soon, however, as the steam-pressure rises above a certain point the quantity of steam introduced is very soon sufficient to furnish all the oxygen necessary for the complete combustion of the carbon of the naphtha to carbonic acid. Thus, we are enabled by a correct interpretation of Nature's laws to explain fully and satisfactorily the paradoxical fact that the greater the heat, the less the consumption of oil. We know that instead of two volumes of hydrogen in the first, we must have four in the second case.

There is one other point which I may probably feel called upon to treat of, viz.: the utter invisibility of this tremendous fire. For the present the above will suffice.

DR. GÜNTHERS ICHTHYOLOGY.*

Less than a century ago the last edition of the Systema Naturæ of Linnæus, published in 1766, was taken as the basis and text of essentially a new compilation by Johann Friedrich Gmelin, and among the species admitted by Linnæus were intercalated those subsequently added by others to the system. There were very many duplications arising from the imperfect acquaintance of the compiler with his subject, but nevertheless, all told, only 826 species of fishes were named. There are now known, in round numbers, nearly ten thousand species. In the interval between the compilations of Gmelin and the present were published works of a like nature, by Walbaum, Lacépède, Bloch, Schneider, and Shaw. These were all finished before 1804, and were all of very little value. For considerably more than half a century no other descriptive general enumeration of fishes was completed. Meanwhile, from 1828 to 1849, Cuvier and Valenciennes gave to Ichthyology 22 volumes of a work designed to be a general natural history of fishes, but this was never finished. At last, in 1859, was commenced and in 1870 brought to an end, a work purporting to enumerate all the species of fishes known to the dates of publication, by Dr. Albert Günther, under the auspices of the British Museum. For this contribution the scientific world was laid under great obligations to the author as well as publisher. It was a compilation requiring considerable skill and acquaintance with the literature, and the work may be said to have been moderately well performed. Its author followed the outlines of classification proposed many years before by the illustrious Johannes Müller. On the whole this was the best course, perhaps, to be taken at the time. In 1861, however, he gave a systematic re-arrangement of the Acanthopterygian families, which was above all characterized by an excessive valuation placed on very trivial charac-

* An introduction to the study of fishes. By Albert C. L. G. Günther. Edinburgh: Adam and Charles Black. 1880.

ters, and was, in some respects, a step backwards, although of not very much moment.

Another and most radical modification—the next stage—may be fitly noticed in the author's own words. [1.] "The discovery (in the year 1871) of a living representative of a genus hitherto believed to be long extinct, *Ceratodus*, threw a new light on the affinities of fishes. [2.] The author who had the good fortune of examining this fish, was enabled to show that, on the one hand, [3] it was a form most closely allied to *Lepidosiren;* on the other, that it could not be separated from the Ganoid fishes, and therefore that also [4] *Lepidosiren* was a Ganoid: a relation pointed out already by Huxley in a previous paper on 'Devonian Fishes,' [5] This discovery led to further considerations of the relative characters of Müller's sub-classes, and to the system which followed in the present work" (pp. 25-26). In regard to this claim there are several noteworthy and characteristic features.

(1) In 1870, in Dr. Günther's Cat. Fishes Brit. Mus., vol. 8, p. 323, it is expressly admitted that "after [the 'sheet' descriptive of *Protopterus* and *Lepidosiren*] had passed through the press, Mr. Krefft informed me of the most interesting discovery that a living representative of *Ceratodus* had been found in Queensland. Nothing of this genus was hitherto known beyond teeth, as those described and figured by Agassiz in Poiss Foss. iii, p. 129, pls. 18-20." (2) Dr. Günther knew nothing whatever of *Ceratodus* till he received a communication respecting it from Mr. Krefft. (3) As indicated by Dr. Günther himself (Trans. Royal Soc., v. 161, for 1871), Mr. Krefft, in even the title of his paper, published April 28, 1870, and before Dr. Günther's "reply had time to reach Mr. Krefft," recognized the affinity of the genus to *Lepidosiren.* (4) As early as 1860, Gill (as Brandt, Peters, Lütken and others subsequently recognized) showed that "*Lepidosiren* was a Ganoid," and that *Polypterus* was a type intermediate between the ordinary Ganoids and the Dipnoi. (5) Consequently the only novelty in Dr. Günther's work was "the system which is followed in the present volume," which has been pronounced by an eminently competent judge to be "a triumph of systematic *gaucherie.*" Whatever is true in the statements examined had been appreciated before Dr. Günther labored and only what is untrue to nature and to science was original with him. The co-ordination of the facts enumerated was the necessary logical result of the successive steps.

But what is "the system which is followed in the present work?" Only the salient features may be noticed, and these will sufficiently appear from the enumeration of the sub-ordinal, ordinal and super-ordinal groups. These are:

I. Sub-Class—Palæichthyes.
- I. Order—Chondropterygii.
  - I. Sub-order—Plagiostomata [Sharks and Rays].
  - II. Sub-order—Holocephala [Chimæroids].
- II. Order—Ganoidei.
  - I. Sub-order—Placodermi [Extinct].
  - II. " —Acanthodini [Extinct].
  - III. " —Dipnoi.
  - IV. " —Chondrostei.
  - V. " —Polypteroidei.
  - VI. " —Pycnodontoidei [Extinct].
  - VII. " —Lepidosteoidei.
  - VIII. " —Amioidei.

II. Sub-Class—Teleostei.
- I. Order—Acanthopterygii.
- II. " —Acanthopterygii Pharyngognathi.
- III. " —Anacanthini.
- IV. " —Physostomi.
- V. " —Lophobranchii.
- VI. " —Plectognathi.

III. Sub-Class—Cyclostomata.

IV. Sub-Class—Leptocardii.

To those familiar with the facts and details of the anatomy of fishes and the inferior vertebrates, this enumeration will be its own best commentary. Suffice it for the present at least to affirm that it involves more contradictions and inconsistencies than have been manifested in any recent taxonomical exposition of any class of animals emanating from a respectable source.

Almost equally in disaccord with the cultivators of the other branches of Vertebrate Zoology is Dr. Günther in his treatment of Genera.

The extreme of differentiation is practiced by ornithologists, (provided the differences are obvious and external), and a course is pursued in mammalogy which has received the sanction of the greatest number of students of that class, during at least the last quarter of a century. American ichthyologists have endeavored to comply with the principles on which genera in the latter class have been recognized as much as the differences of facts will permit, and although, of course, there are many disagreements as to detail, there is an essential congruity between them. The principles, if any, applied by Dr. Günther are undiscernable from his work. His methods indeed, seem to have varied with the whim of the moment and to have been modified for each case: the results then happening appear for him to have crystallized and not to have been subject to review or further consideration afterwards. Strange contrasts constantly occur in the extension or limitation of the groups. In the genus *Tetrodon*, for example, is discoverable a very considerable range of variation, not only in external features but still more markedly in the details of structure, and especially in the bones of the head. So great are these that there are three well defined major groups and a number of minor ones entitled to generic distinction, but, nevertheless, our author has refused to admit more than one "genus" for all the representatives of the type, whereas, in the related group of Diodontines, he has recognized a number of genera upon characters of very much less moment, such as the development of the spines, nostrils, &c. Under the genus *Gasterosteus* are confounded all the representatives of the family of Gasterosteids, and yet upon differences of the same kind as those which distinguish, for example, the "*Gasterosteus spinachia*" from the other species of *Gasterosteus*, are elsewhere constituted distinct *families.*

These examples might be extended indefinitely. Heterogeneous combinations of forms on one hand chance in strange contrast with isolated generic types on the other.

Comprehensiveness of genera *per se* is not a great evil, provided there is consistency in the treatment of the subject, and that all share as nearly alike as the nature of the case allows. It is to the assignment of inordinate value to a few superficial characters, and the subordination, to the manifestation of such, of other characters whose coincidence demonstrates them to be of greater importance, that we object. It is true that the acceptance of such comprehensive groups isolates in a measure the class in which they are recognized from others and tends to constantly mislead the inquirer who would compare the constituents of the several classes, *e. g.*, as to their geographical or geological relations. Even this, however, is of minor importance. It is the utter disregard of the gradations of structural differences exhibited by Dr. Günther in his constitution of genera that detracts so much from the value of his work. To enter into detail would necessitate space equal to the portion considered, and some instances must suffice.

Serranus (p. 381) is distinguished among its allies by the "small scales," presence of "very distinct canines in both jaws," and the absence of serratures from the lower margin of the preoperculum. Under the genus thus defined, there are not only species which disagree with the principal characters, but the *typical Serrani (S. cabrilla, S. scriba,* etc.) are more nearly related to the species of *Centropristis* than to the rest of their associates. A natural arrangement—*i.e.* one based on their anatomical details—would require, first, the fusion of the Güntherian genera *Centropristis, Anthias, Callanthias, Serranus, Anyperodon, Prionodes, Plectropoma*, and *Trachypoma*; then the wide removal of certain forms, and finally the disintegration of the conglomeration on an entirely different basis from that accepted by Günther.

The instances wherein genera are referred to families with the diagnoses of which they diametrically disagree are numerous. Leaving out of consideration cases of conflict of genera or species with the characters assigned as *ordinal* to the including group (e. g., *Pogonias, Sciæna, Gerres*) the following are examples:

The genus *Dactyloscopus* is referred to the family Blenniidæ, in which the spinous portion of the dorsal fin is said to be "as much developed as the soft, or more." *Dactyloscopus* has in the most evident manner, notwithstanding the erroneous definition of Günther (Catalogue of the Fishes in the British Museum, Vol. III., p. 279), only the first ten to twelve dorsal rays spinous, all the others being articulated. In fact, *Dactyloscopus* has nothing whatever to do with the Blenniidæ, but is very closely related to *Leptoscopus*, and belongs unquestionably to the same group; in other words to an entirely different division of fishes in the Güntherian system. (See Trachinidæ p. 462.)

The genus *Zoarces*, (p. 497) also referred to the family of Blenniidæ, still more disagrees with the true representatives of that family in the structure of the dorsal fin and, as he himself admits, has "no other fin spines" than a few near the caudal; it shows, in fact, an organization similar to that manifested in the family Lycodidæ of Günther, (p. 537) placed by him in a different *order* of fishes—the Anacanthini.

Siphonognathus is a remarkable genus referred to the family of Labridæ. This family is defined as having, in addition to other characters, "the soft anal similar to the soft dorsal, ventral fins thoracic, with one spine and five soft rays," and "branchiostegals five or six." Nothing whatever is said respecting the anal, ventrals, or branchiostegals of *Siphonognathus* and as the necessary data are thus entirely suppressed, it would naturally be assumed that the genus would have the characters attributed to the family. In fact, however, *Siphonognathus* has not the "soft anal similar to the soft dorsal," there are *no* ventral fins, and there are only *four* branchiostegal rays. It will be thus apparent that it would be impossible to identify this fish from Dr. Günther's Introductiou, unless it were assumed that great blunders had been made. This is indeed the case, but it is not safe to assume that the author is an habitual blunderer, and to proceed on that basis, even in the case of Dr. Günther. We are somewhat prepared, however, for the idiosyncrasy exhibited by Dr. Günther, when he compares the relationship of *Siphonognathus* to *Odax* as being similar to that of *Babirussa* to *Sus* (see Catalogue of Fishes in B. M., v. 4, p. 243). Any one who can really entertain such views, and consider the differences between the mammalian genera to be of the same kind or degree as those between the fish genera is unfit to institute comparisons.

Numerous genera are adapted, which, although they may be good, consistency would require Dr. Günther to merge with others. Thus we have *Ptyonotus* (which he has unnecessarily substituted for *Triglopsis* of Girard) retained for a form in the family of Cottidæ (p. 480); this is, however, far more closely related to the "*Cottus quadricornis*" of Günther than are any of his other species of that heterogeneous group. *Pammelas* is still retained as the name of a distinct genus which is allied to *Trachynotus*, although it had been named before Dr. Günther applied his, and its affinities have been well-known for many years to be with *Centrolophus*: it is indeed to a species of that genus (the *C. ovalis*), that the *P. perciformis* is most closely related, and yet in spite of the concurrent testimony of previous ichthyologists we find it injected, in the "Introduction to the Study of Fishes," into a family remote from that to which *Centrolophus* has been referred. As examples of other forms unnaturally separated we may instance (1) *Chætopterus* (p. 390) and *Aprion* (p. 397); (2) *Grystes* (p. 392) and *Huro* (p. 393), and (3) *Auliscops* and *Aulorhynchus* (p. 508). The last type, it may be remarked, is more nearly related to the so-called *Gasterosteus spinachia* than to the Fistulariidæ and should be either referred to the same family or differentiated as a distinct one.

Changes of the names of established genera on trivial pretexts are also indulged in. The name of *Triglopsis* was abandoned for *Ptyonotus* because there was a *Triglops* previously established. Although they are unquestionably much alike, they are sufficiently different, and Steindachner has even lately named a genus *Atherinops*, knowing well that *Atherinopsis* had already been proposed for another genus of the same family. *Dactylopus* is discarded for *Vulsus* because, forsooth, the term DACTYLOPODA had previously been applied by Meyer to a group (not genus) of extinct reptiles. And yet our author himself retains both *Chondrosteus* and Chondrostei etc., without the slightest demur. *Xiphasia* is rejected with an exclamation mark (!) and the yet more objectionable name *Xiphogadus* proposed because the author was dissatisfied with the name, and—we strongly suspect—still more with the namer (Swainson). Why expect any better reason?

The idea is conveyed in the work—and that it has been extensively claimed elsewise by our author is no secret—that all the established genera are admitted in this volume. Without counting the scores of genera that Dr. Günther refuses to recognize, but which every one applying the canons observed by mammalogists and ornithologists would adopt, there are many which even that author could scarcely neglect unless through ignorance. Among those omitted, and which are especially interesting, on account of representing previously unknown types of high value (families or sub-families), or because they throw light on the relations of families in which they belong are: *Elassoma, Xenichthys, Hoplopagrus, Gnathanacanthus, Nematistius, Grammicolepis, Bathymaster, Cottunculus, Oxylebius, Anoplopoma, Dactylagnus, Myxodagnus, Anarrhichthys, Plagiotremus, Chænopsis, Nematocentris* and *Protistius*. If he had really known *Hoplopagrus* (referred to incidentally on page 279, but not otherwise noticed), he, *perhaps*, would not have so far separated his "*Percidæ*" (pp. 375-379) and "*Sparidæ*" (405-410), as he has done: if he had known *Cottunculus* he would, *perhaps*, have recognized the affinity of *Psychrolutes* to the *Cottidæ*, and not isolated it as the type of a remote family—at least no scientific ichthyologist would have failed to so profit by the knowledge. The work of Bleeker, Steindachner, Klunzinger, Lütken, Vaillant, Sauvage, Giglioli and Collett in Europe, and that of all American ichthyologists has, however, been almost of nought so far as Dr. Günther is concerned. It need be only remarked, in connection with the latter, that of the numerous genera of Etheostomine fishes only *Pileoma* (*Percina*) and *Boleosoma* (p. 379) are recognized. The reason therefore is no secret—they are too small, and as they have not been able to grow larger, they do not deserve to be considered. The interesting relations, physiological and morphological, that they present are not sufficient to outweigh this cogent objection. Among American fishes there is no group that has been so much written about and that is better known than the genus *Micropterus*, but notwithstanding Dr. Günther has not yet learned that he has distributed its well defined representatives under three genera, nor that *Huro* was based on a mistake and is not a valid genus, nor that there are two, and only two, well-determined species, and those two can not be generically distinguished. When it is further remarked that only three genera are recognized for the Centrarchines and Lepomines, and that these are diagnosed by the least important and most fallacious characters, and that thereby the species are thrown into almost inexplicable confusion, some idea may be formed of the unreliability of the work.

The general anatomical portion of the work is, on the whole, really a tolerably good *résumé* of facts respecting the structure and organization of fishes, for the author has wisely followed Gegenbaur, Huxley and Parker without sufficient deviation to fall into much error. One great objection to it, however, is the undue prominence given to the peculiarities of the teleostean types and the exhibition of them in such a manner as to prevent the reader's conception of the range of variation in the forms treated of, and especially as to the taxonomic value of such variations. In this connection too, we may notice the reproduction of some rather strange views. Thus, it is said that "the numbers of the dorsal and anal rays give good specific, generic, or even family characters," except when greatly increased, while "the taxinomic [taxonomic] value of this character becomes uncertain. The numbers of the pectoral and caudal rays are rarely of any account" (p. 44). The last remark embodies a striking illustration of the length to which Dr. Günther's neglect carries him in contempt of the facts. Far from the number of the completely developed caudal rays being of no account, there are rarely deviations in the number in related forms, and when such prevail they generally accompany other decided modifications of structure and are available for major diagnostic purposes, as Bleeker has observed. Again, it is claimed of the pectoral limb that the structure of that of *Ceratodus* "*evidently*" represents one of its first and lowest conditions" (p. 74). So far is this from being "evident" that it is difficult to understand how any one familiar with the stucture and development of the limb in the Selachians and related types, and conversant with the logic of science could entertain for one moment such an opinion and, on the contrary, not look upon the Ceratodontoid limb as an extreme deviation from the primitive type. But the very climax of absurdity and unscientific comparison is exemplified in the case of *Ceratodus* by the homologisation of the basal segment of the axis of the pectoral *fin* (not that which supports it) with the basal cartilage of the Sturgeon, and which itself is the source of several other errors (pp. 74, 76). A comparison of the pectoral limbs of *Ceratodus* and *Polypterus* would be sufficient to prevent any scientific naturalist from making such a blunder. We need not dwell further on such defects but in connection with the systematic portion, we cannot omit to notice that Dr. Günther recognizes that in the Chondropterygians there are no bones representing the membrane bones of the skull of the Ganoid and higher fishes; that at the most there are simply "rudimentary maxillary elements" (p. 69); that the scapular arch "is formed by a single coracoid cartilage" (p. 69); that "the same type of branchial organs [as in the Cyclostomes] persists in *Chondropterygians*, which possess five, rarely six or seven, flattened pouches with transversely plaited walls," each pouch opening "outwards, and by an aperture into the pharynx, without intervening ducts" (p. 137); and that an "air bladder is absent but occurs in all Ganoids," etc. (p. 141), and that the generative organs are very peculiar (p. 166). Yet in spite of all these differences, in face of the recognized similarity between the teleosteoid Ganoids (*Amia*, &c.) and certain Physostomes, and in ignorance of the evanescence of the characters designed to differentiate the Teleosts, he adheres to the combination of the Ganoids with the Chondropterygians in one sub-class—the Palæichthyes. It is indeed a "singular concurrence" of characters (p. 312)—but not of important ones—that is employed to segregate this group, for not one is common to all the members included in it, and at the same time exclusive of other types. A knowledge of the anatomical labors of recent biologists would have instructed him as to this fact. The "Sub-class Palæichthyes" is indeed, as has been said by a recent well qualified iudge, "a triumph of systematic *gaucherie*." The group in fact is the outcome of a confusion of ideas respecting generalized characters and extravagant valuation of certain facts entitled to consideration but by no means to anything like the extent admitted.

Quite as inscrutable as his Morphology is Dr. Günther's Physiology. As we turn the pages of the Introduction we come across strange assertions respecting the functions connected with structural peculiarities. Several of these may be taken as examples.

The power of ejecting from the mouth drops of water to some distance, and with such force as to dislodge insects and precipitate them into the water, has been attributed to more than one Javanese fish, but whether the real shooter was a *Chelmo*, a *Toxotes*, or an *Epibulus*, or each one, (or even whether any actually had such power), seems to have become doubtful. Skepticism as to any case might have been legitimate, but Dr. Günther unqualifiedly asserts that as to *Chelmo* "*this statement is erroneous*," and that the feat "*is practised* by another fish of this family (*Toxotes*). The long slender bill of *Chelmo* (which is a true salt-water fish) rather enables it to draw from holes and crevices animals which otherwise could not be reached by it" (p. 399). *Toxotes* has an unusually deeply cleft mouth, and one less fitted to perform such a feat as that in question could scarcely be found. The inaptness of the structure to the alleged function might well evoke skepticism in anyone, and this being once excited, the literature respecting the several fishes which have been named ejaculators will demonstrate that (1) there is no *observational* basis for the attribution of blowing drops of water to the *Toxotes*, and (2) there have been observations (by Hommel, Reinwardt and Mitchell), of a certain kind, of ejaculatory feats by *Chelmo*. In fact, if it is conceded that the feat is performed by a fish, in the sentences repeated from Dr. Günther, there are concentrated seven distinct errors: (1) denial in spite of evidence, (2) affirmation without sufficient basis, (3) denial in face of (comparative) adaptation of structure to function, (4) credulity in spite of inaptness of structure to function, (5) gratuitous assumption of a function—"to draw from holes and crevices animals which could not otherwise be reached by it," (6) the assumption, by implication, that the Archer was not a salt-water type, although the first observer (Hommel) especially stated that it was a sea-fish, and (7) erroneous taxonomy in the association of *Toxotes* in the same family with *Chelmo*. Almost all possible kinds of errors have thus culminated in this single case.

An instance of another gratuitous assumption respecting a function, refers to a Sciænoid fish.

The genus "*Collichthys* Günther" (previously named *Sciænoides* by Blyth) is distinguished by a "great development of the muciferous system on the head and the small eye," and this characteristic "leads one [and but one—Dr. Günther alone] to suppose that these fishes live in muddy water near the mouths of large rivers" (p. 430). What teleological relation there is between muciferous channels and small eyes and the muddy water of large (or any kind of) rivers, Dr. Günther has not vouchsafed to inform us. That such characteristics do not usually indicate the conditions suggested, is admitted by Dr. Günther himself, for he has recognized that "the muciferous system of many deep-sea fishes is developed in an extraordinary degree" (p. 300), and that a large portion of the deep-sea forms are characterized by small eyes (pp. 300-301). The fact is that instead of the inference in question being the outcome of a consideration of the structure indicated, it is the result of data concerning the habitat of one species of the genus and the desire to connect the structure with some function, however irrelevant. It is recorded in the "Catalogue of the Acanthopterygian Fishes in the British Museum" (v. 2, p. 316)—a work which has served as the basis of the "Introduction to the Study of Fishes"—that the "*Collichthys pama*" inhabits the "Bay of Bengal, entering rivers." The statement given as a deduction is therefore really a co-ordination—and an entirely sophistical one—of the ascertained structural peculiarity and the habitat of that species.

One other characteristic deduction, also relating to a Sciænoid type, may be noticed because of its interest to American students.

The "Drum" of the Atlantic (*Pogonias chromis*) is especially mentioned in connection with "the extraordinary sounds which are produced by it and other allied Sciænoids." "It is [says Dr. Günther] still a matter of uncertainty by what means the "Drum" produces the sounds. Some naturalists believe that it is caused by the clapping together of the pharyngeal teeth, which are very large molar teeth. However, if it be true [sage proviso !] that the sounds are accompanied by a tremulous motion of the vessel, it seems more probable that they are produced by the fishes beating their tails against the bottom of the vessel in order to get rid of the parasites with which that part of their body is infested." In this paragraph are several illegitimate assumptions and inferences which a slight knowledge of the literature respecting the subject would have prevented. (1) The sounds are entirely independent of "vessels." (2) There was no reason to suppose that the fish in question was more infested with parasites in the tail than any other. (3) The statement that "allied Sciænoids" (and this is especially true of the closely related fresh-water sheepshead, or *Haploidonotus*, referred by Günther to a genus with which it has not the slightest affinity!) produce similar sounds was for the moment forgotten. (4) The co-ordination of facts and phenomena rendered it unnecessary to look to such source for solution. (5) The source indicated was one of the most improbable that could be conceived. There is, indeed, ample cause for surprise that any educated ichthyologist could suppose that a fish would agitate its tail in the manner suggested to relieve a spasmodic pain, such as is postulated by the explanation given. Our author's credence in the allegation that the sounds produced are "accompanied by a tremulous motion of the vessel," was, as we have seen, sufficient to impel him to substitute a most improbable for at least a probable hypothesis.

A mistake of another kind is made respecting the Rays. It is said that "the majority are *oviparous*" (p. 336). As was long ago recognized by Müller and Henle, the Raiidæ are the only oviparous rays; Gunther includes them all in one family and four genera, and admits about 35 species. All the others recorded by him, so far as known, are viviparous; they number, in his opinion, five families, twenty genera and more than 100 species, consequently the majority are *viviparous !*

Whether a work so abounding in errors that we are only able to specify a few as examples and hint at some kinds of others is worth acquiring must be left to the reader to judge. As a curiosity in taxonomical literature it certainly *is*, but for such purposes as are most desirable—correct information and identification of genera—it as certainly *is not.*

THEO. GILL.

DESCARTES AND THE BAROMETRIC THEORY.—At one of the late sittings of the Academy of Moral and Political Science, M. Nourisson made an extremely interesting communication relative to a letter of Descartes, in which the great philosopher clearly indicates the principal of atmospheric pressure, twelve years before Toricelli's experiments on the barometer. Toricelli constructed the fast barometric tube in 1643; in 1647 Pascal accomplishes his celebrated experiments of Puy-de-Dôme and of the "Tour Saint Jaques." It would appear that Descartes had suggested to the author of *Pensées* the idea of this mode of experiment.

CORRESPONDENCE.

To the Editor of SCIENCE:

ON ETHER.

There are two theories in regard to ether, one of which assumes that it is a discontinuous medium, that is, a medium composed of particles at enormous distances apart, as compared with their diameters.

In this theory ether is spoken of or defined as an "imponderable elastic medium." If we examine the above definition we find several inconsistencies. To begin with, an imponderable body is a body without weight. Now the weight of a body, is the result of the mutual attraction, exerted between it and some other body; in other words, weight is the effect of gravitation. Now as every particle attracts every other particle with a force, that is directly as the mass, and inversely as the square of the distance between them, an imponderable body must be one in which the mass is zero, or that is at such a distance from every other body that the reciprocal of the square of this distance is zero. The last supposition is of course absurd.

Now the mass of a body is equal to the product of its volume and density, or $M=d\ V$ and if M is equal to zero, either d or V must be zero and as it would be impossible to conceive of a body that occupies no space, we must think of d as equal to zero, or in other words an imponderable body is simply a portion of space. This same theory assumes that radiant energy is transmitted by means of the moving particles of ether, *i. e.*, one particle moving with a certain velocity, strikes another and imparts some of its energy to it and this flying off strikes another and so on. But the momentum of a body is expressed by $M\ V$ and its energy by $\frac{M V^2}{2}$ (V=Velocity), making M equal to zero, as we must if the particles are imponderable, we have $O\ V=M_0=o$ and $\frac{O\ V^2}{2}=E=o$, hence the transmission of radiant energy by an imponderable substance, composed of particles is an impossibility. If we assume that the particles are effected by gravitation, then at once it is evident that the ether could not be of equal density throughout the universe, for around each celestial body there would be an atmosphere of ether which would gradually decrease in density from the surface of the body outwards.

By elasticity in the above definition, is meant that property of matter, possessed by gases in the highest degree, of having its volume or density changed by some force and regaining its former state when the original condition are again imposed. When a gas is compressed, the mean free path of the molecules is shortened and the compressibility is dependent upon the length of the mean free path. When the pressure is removed, the gas expands, the expansion being due to a conversion of the energy of vibratory motion of the molecules or heat into energy of translation. If the ether is elastic, then of course with a change from less to greater density the particles must be moved nearer together, and the compressibility will be dependent upon the average distance between the particles. When a change from greater to less density takes place, the particles must be moved farther apart and the explanatory reason given for this expansion is that the energy of the moving particles causes the expansion.

From what has been said in regard to imponderability, it is evident that a discontinuous imponderable elastic substance is an impossibility according to the present ideas of dynamics. The transmission of radiant energy by a discontinuous ether, if the particles are ponderable, is possible in two ways, 1st, By an alternate rarefaction, and condensation of the ether, similar to the manner in which sound is transmitted through air. 2d, By the