

Zealand near lat. 40°, and the isothermal of 50° near Dunedin; now the mean temperature of January at Southland situated at the extreme south of New Zealand is 57°·6, and at Duned in (550 ft. high) 57°·5; in other words, the isothermal of 60° and not that of 50° ought to pass near Dunedin. Dr. Hector's meteorological reports during the past seven years place this beyond all doubt, and it is unfortunate that the summer climate of this important colony of Great Britain should have been so misrepresented as to appear to be colder than that of Iceland, and altogether insufficient for the ripening of wheat, barley, and other cereals. The July isothermal of 90° is represented as having its eastern extension at the entrance to the Persian Gulf in 57° E. long. Now Murray Thomson's and Blandford's meteorological reports show that the isothermal of 90° extends eastward to about 77° E. long, so as to embrace the Punjab and the upper tributaries of the Ganges to the west, being thus 20° farther east than is represented on the chart.

The truth is, that, excepting for the months of January and July, there have been no isothermal charts of the months for the whole globe yet published which do not contain many gross errors similar to those we have pointed out. The time is surely not far off when a committee of the British Association, or some competent authority, will take up this subject, and give us a set of new isothermal lines laid down from all data which the great expansion meteorology has received of late years has made available.

The two charts showing the isothermals of the sea for the extreme months, February and August, and the chart showing the surface currents of the ocean, are very valuable. A supplementary chart showing the currents south and east of Asia during the monsoon season is also given. We should suggest for the second edition of the Charts, that charts of the surface currents for both February and August should be given for the whole globe, it being only thus that these important aids to navigation can be adequately presented.

It was pointed out in NATURE some years ago that the prevailing winds and surface currents of the Atlantic are all but absolutely coincident. These Charts enable us now to extend the remark to the prevailing winds and surface currents over all the oceans. Keeping out of view the deep-water currents of the sea to which Carpenter has given so much attention, it is now placed beyond all doubt that it is to the winds we must look as the prime movers of oceanic currents.

MR. GARROD'S NEW CLASSIFICATION OF BIRDS

AT the scientific meeting of the Zoological Society, on Tuesday, February 3, Mr. A. H. Garrod introduced a new Classification of Birds, based mainly on the disposition of their muscles and other soft parts. The following is an abstract of his paper:—

The osteology of birds, judging from the unsatisfactory state of their classification in the present day, is not sufficient in itself as a basis for distinguishing the mutual relations of the different families and genera; and as the peculiarities in the soft parts are very constant, they deserve more consideration than they have hitherto received. The researches of Hunter, Nitzsch, Macgillivray, Owen, and others, have brought to light many facts in visceral anatomy and pterylosis, all of which are of great value in classification. Sundevall is the only ornithologist who seems to have made any generalisations respecting myology, and these have an important bearing on the subject.

My method of work, Mr. Garrod went on to say, has been the following:—After having carefully dissected a few birds that are known to be but distantly related, a comparison of the notes on

the individuals examined showed that there were important myological differences between them. Further dissection of species related more or less intimately, indicated broadly the relative value of the peculiarities that were found, when taken in connection with the most approved classification of the present day; and as observations became more numerous the relative importance of the facts observed was more easy to estimate. The muscles which have, on account of their marked tendency to vary in the class Aves, attracted the most of my attention, are all situated in the thigh, and they are five in number: (1) the *femoro-caudal*, which runs from the linea aspera of the femur, near its head, to the sides of the tail vertebrae; (2) the *accessory femoro-caudal*, which runs parallel to the last, and behind it, from below the femur-head to the ischium; (3) the *semitendinosus*, which crosses the first-named muscle superficially, and arises from the lower part of the ischium, to be inserted into the inner side of the tibia-head; (4) the *accessory semitendinosus*, which arises from the distal end of the linea aspera, and joins the fibres of its larger namesake obliquely just before their insertion; (5) the *ambiens*, that peculiar slender muscle which arises from just above the acetabulum, and after running obliquely through the ligamentum patellæ, joins the tendon of the flexor perforatus digitorum. My observations on these five muscles have been made on more than 500 species of birds, including more than 600 specimens, and the results are recorded in a tabular form, in a paper now in course of publication in this Society's Proceedings. For the present, no more attention need be paid to these muscles themselves, but only their presence or absence considered; therefore, to simplify description, a myological formula will be employed which indicates all the facts required in a very precise manner. Calling the first four of the above-mentioned muscles, A B X and Y, respectively, and omitting from the formula thus based, the symbol or symbols which represent any that are deficient, it is clear that a bird, like the common fowl for example, which possesses them all, would be represented by ABXY; and the eagle, in which the femoro-caudal is alone present, by A; whilst the sparrow, which only wants the accessory femoro-caudal, must have the formula A X Y; and the duck, which only lacks the accessory semitendinosus, is represented by A B X. By this means it is possible to make important statements respecting the myology of any bird in a very concise form, which gives great facility towards the comparison of different species. It must here be mentioned that individuals of a species and species of a genus do not vary among themselves in the muscles under consideration. The following table gives the myological formula of the different families of birds, as far as my dissections enable me to go, the only important types omitted being Eurypyga, Psophia, Todus, and Bucco. They are arranged in an order to be subsequently explained, and the presence or absence of the ambiens-muscle is indicated by + or — after each formula:—

TABLE I.

Struthionidæ B X Y +	I.
Casuariidæ { A B X Y —	
{ B X Y —	
Tinamidæ A B X Y +	<i>Picidæ</i> { A X Y —
Palamedeidæ A B X Y +	{ A X —
Gallinæ { A B X Y +	<i>Ramphastidæ</i> A X Y —
(excl. Turnix) } B X Y +	<i>Capitonidæ</i> A X Y —
Rallidæ A B X Y +	<i>Upupidæ</i> A X Y —
Otididæ B X Y +	<i>Eucerotidæ</i> A X Y —
(Incl. Cariama and Serpentarius.)	<i>Alcedinidæ</i> A X —
Phenicopteridæ B X Y +	
Musophagidæ A B X Y +	II.
Centropinæ A B X Y +	
Cuculinæ A X Y +	<i>Passeres</i> { A X Y —
Psittaci A X Y ±	{ A X —
Anatidæ A B X +	<i>Trogonidæ</i> A X —

Spheniscidæ A B X +	<i>Meropidæ</i> A X Y—
Colymbidæ A B X +	<i>Galbulidæ</i> { A X Y—
Podicipidæ B X —	{ A X —
Procellariidæ { A B X Y +	<i>Caprimulgidæ</i> A X Y—
{ A B X +	<i>Steatornithidæ</i> X Y—
{ A X +	<i>Coraciidæ</i> A X Y—
Ciconiidæ A X Y +	<i>Momotidæ</i> A X Y—
Cathartidæ { A X V +	
{ X Y +	
Ardeidæ { A X Y—	III.
{ X Y—	
Phalacrocoridæ A X +	<i>Cypselidæ</i> A—
Phaethontidæ A X Y +	<i>Trochilidæ</i> A—
Fregatidæ A +	
Falconidæ A +	
Strigidæ A —	
Gruidæ A B X Y +	
Charadriidæ { A B X Y +	
{ B X Y +	
Laridæ A X Y +	
Alcidæ A B X —	
Columbæ A B X Y ±	

On looking at the formulæ in the above table it will be seen that there is a tendency to similarity in those that are placed in juxtaposition; and further, that the presence or absence of the ambiens muscle, indicated by the signs + and —, is more constant than the other characters. Thus, among the *Cuculidæ*, the *Picidæ* and *Ardeidæ*, the ambiens does not vary whilst one or other of the rest is inconstant. There are more reasons than the above for assigning primary importance to the ambiens muscle, which depend on the nature of the tip of the oil-gland and the cæca of the intestine. For, with but few exceptions, those birds which possess the ambiens muscle have cæca to the colon and a tuft of feathers on the oil-gland, whilst those in which the ambiens muscle is absent, have either cæca and a nude oil-gland, or a tufted oil-gland and no cæca. The true relationship of the exceptions is, however, indicated by other collateral characters, the most important of which is the presence or absence of the accessory femoro-caudal (B); that muscle being never found in those birds in which the ambiens is always absent, so that any bird with it developed, is certainly related to those in which the ambiens is present. These facts lead me to propose the division of the class Aves into two primary sub-classes,—the *Homalogonati*,* in which the ambiens is present, and the *Anomalogonati*† in which it is always absent. The former of these are printed in the above table in Roman letters, the latter in italics.

It may be asked, why, on the above principles, are the Ardeidæ and the Strigidæ placed with the Homalogonatus birds, especially as the latter have a nude oil-gland? The position of the latter of these two families is no doubt uncertain, but the sum of characters is in favour of the places assigned to it.

Next, respecting the most important sub-divisions of the Homalogonatus, and the Anomalogonatus birds. Taking the latter first, because they are fewer in number, and more clearly separable, they are found to fall naturally into three well-defined orders:—(1) those in which the oil-gland is nude and the cæca of the intestine present; (2) those in which the oil-gland is tufted and the cæca are absent; and (3) those in which the oil gland is nude and the cæca are absent. These three sections of the Anomalogonatus birds are indicated in Table I. by the corresponding numbers, the *Picidæ* heading the first, the Passeres the second, and the third comprising the Macrochires only. To most ornithologists the not unreasonable of this arrangement will be fairly apparent.

* With the knee normal; that is, with the ambiens crossing it.
† With the knee abnormal; that is, with the ambiens deficient.

TABLE II.

Class AVES

Sub-class HOMALOGONATI

Order I. GALLIFORMES

Cohort (a) STRUTHIONES

Family 1. *Struthionidæ*

Sub-fam. 1. *Struthioninæ*

2. *Rheinæ*

3. *Casuariidæ*

4. *Apterygidæ*

5. *Tinamidæ*

(β) GALLINACEÆ

Family 1. *Palamedeidæ*

2. *Gallinæ*

3. *Rallidæ*

4. *Otididæ*

Sub-fam. 1. *Otidinæ*

2. *Phœnicopterinaæ*

5. *Musobhagidæ*

6. *Cuculidæ*

Sub-fam. 1. *Centropinæ*

2. *Cuculinæ*

(γ) PSITTACI (†)

Order II. ANSERIFORMES

Cohort (a) ANSERES

Family 1. *Anatidæ*

2. *Spheniscidæ*

3. *Colymbidæ*

4. *Podicipidæ*

(β) NASUTÆ

Family 1. *Procellariidæ*

2. *Fulmaridæ*

Sub-fam. 1. *Fulmarinæ*

2. *Bulweriinaæ*

Order III. CICONIIFORMES

Cohort (a) PELARGI

(β) CATHARTÆ

(γ) HERODIÆ

(δ) STEGANOPODES

Family 1. *Phaethontidæ*

2. *Pelecanidæ*

3. *Phalacrocoridæ*

4. *Fregatidæ*

(γ) ACCIPITRES

Family 1. *Falconidæ*

2. *Strigidæ*

Order IV. CHARADRIIFORMES

Cohort (a) COLUMBÆ

(β) LIMICOLÆ

Family 1. *Charadriidæ*

2. *Gruidæ*

3. *Lariidæ*

4. *Alcidæ*

Sub-class ANOMALOGONATI

Order I. PICIFORMES

Family 1. *Picariæ*

Sub-fam. 1. *Picidæ*

2. *Ramphastidæ*

3. *Capitonidæ*

2. *Upupidæ*

3. *Bucerotidæ*

4. *Alcedinidæ*

Order II. PASSERIFORMES

- Family 1. *Passeres*
 " 2. *Bucconidæ* (?)
 " 3. *Trogonidæ*
 " 4. *Meropidæ*
 " 5. *Galbulidæ*
 " 6. *Caprimulgidæ*
 " 7. *Steatornihidæ*
 " 8. *Coraciidæ*
 Sub-fam. 1. *Coraciinæ*
 " 1. *Momotinæ*
 " 3. *Todinæ* (?)

Order III. CYPSELIFORMES

- Family 1. *Macrochires*
 Sub-fam. 1. *Cypselinæ*
 " 2. *Trochilinæ*

The Homalognatous birds must be divided upon a different basis, and their myological formulæ here come into service. Before going further it is necessary to show that the habits of the species are not the cause of their myological peculiarities in most cases, though probably in some they do affect them. The Heron and the Swallow have the same formula, and yet how different their habits? the same may be said of the Owls and the Swifts; the Kaleege and the Flamingo. The Auk and Guillemot, however, are most probably but distantly related to the Ducks and Penguins if the peculiarity in the nasal bones has the importance that I assign to it; nevertheless, the muscles of their legs agree more with them, than with the other Schizorhinal birds. By a glance at Table II., the manner in which the Homalognati may be best subdivided according to the facts that I have been able to bring forward, may be obtained. Commencing with the orders, the *Galliformes* include all those birds related to the Fowls; and notwithstanding the high opinions to the contrary, I cannot feel justified in separating the Struthious birds away from this group. It is not difficult, after having seen the formula of the *Musophagidæ* and *Cuculidæ* (Table I.), to recognise that these families have nothing to do with the Anomalognatous birds, although they are peculiar in the former having no cæca, and the latter a nude oil-gland. The Psittaci also cannot be placed anywhere else.

The *Anseriformes* all agree, with the exception of the Storm-Petrels, which are also otherwise difficult to place, in wanting the accessory semitendinosus (Y), and in having the great pectoral muscle very elongate. The whole family of petrels are exceptions in this point also, and may have to be put in the next order, amongst the *Ciconiiformes*.

The *Ciconiiformes* include amongst them the Accipitres, but myology is in no point more clear than with regard to the unnaturalness of that family as at present defined. Every Eagle, Hawk, true Vulture, and Owl, has for formula A. The Secretary Bird, which is generally placed with them, is represented by B X Y; from which it is seen to be as different from them as it can possibly be. This shows that the position of *Serpentarius* must be changed; that it is not a raptorial bird at all; and that, as in formula and general appearance it resembles *Cariama*, it must be placed near it and the Bustards. Similar arguments indicate that the *Cathartidæ* are not true Accipitrine birds, but must form an independent family, though still in the same order as the Falcons.

The *Charadriiformes* all possess the peculiar nasal arrangement which I have termed Schizorhinal. The *Turnicidæ* and *Parridæ* are included with the *Limicoiæ*, and the *Pteroclidæ* with the *Columbæ*.

The justification of many of the smaller divisions of the above orders will be seen by comparing the myological formulæ, and by a review of the osteological, pterylographical, and visceral arrangement of each.

In any attempt at classification on new facts, it must be remembered that there must be great inequality in the

importance of the results arrived at in each order as freshly defined. In one family there may be a uniformity in a particular structure which is greater than could possibly have been expected; whilst in another the previously constant character may be one of the most uncertain. For instance, the left carotid artery is alone present in all the Passerine birds that have ever been examined; but amongst the Bustards the Great Bustard has two, Denham's only the right, and *Tetrax* only the left. Therefore it is not to be wondered at that myology is equally uncertain in its indications sometimes, though on other occasions its teaching is most decided. In the above attempt at a new arrangement, it has been my endeavour to bring forward the results of observations made during a considerable time, with the facts obtained from previous work always kept prominently in the foreground.

NOTES

IN a Congregation held at Oxford on Feb. 10, Prof. H. Smith introduced a statute providing that the certificate of the examiners appointed under the authority of the Delegates of the Examination of Schools, when given in Greek, Latin, and Elementary Mathematics, be accepted in lieu of Responsions. He represented that in Mathematics the standard would be higher than in Responsions; in Greek and Latin it would be equal, owing to the requirement of translation of "unseen pieces." The candidate would also have to pass in some other subject. It was therefore inconceivable that the idle should select the Schools Examination as the easier. The standard would be kept up by the employment of the same class of examiners as in other University examination. The preamble of the statute was accepted.

DR H. ALLEYNE NICHOLSON, Professor of Natural History in University College, Toronto, has been appointed to the Professorship of Zoology in the Royal College of Science, Dublin, vacant by the resignation of Dr. Traquair. Prof. Nicholson is known as the author of many papers on the Graptolites, and as a writer of several text-books of zoology.

THE Smith's Mathematical Prizes have been adjudged to Mr. Walter W. R. Ball, second wrangler, 1874, and Mr. George Stuart, B.A., Emmanuel College, Cambridge, bracketed fourth wrangler, 1874.

A MEETING of those who have signified their interest in the formation of the new Physical Society will be held on the 14th inst., at 3 o'clock P.M., in the Physical Laboratory, South Kensington.

A GENERAL meeting of the Provisional Committee for the establishment of the Scientific Societies Club was held on Jan. 29 at the Westminster Palace Hotel, when an organising committee was appointed with a view to the early opening of the club. The number of "original members" is nearly complete, 231 gentlemen having given in their names. Among the Provisional Committee we notice the names of Dr. Gladstone, Prof. Lawson, and Prof. Morris, and others known to Science.

AT the meeting of the Paris Academy of Sciences on Feb. 2 the place of Correspondent of the Astronomical Section, left vacant by the election of Sir George Airy to a Foreign Associateship, was filled up. M. Tisserand obtained 25 votes and M. Stéphan 23. The former was therefore elected. At the same meeting the Academy, sitting in secret committee, received the report of the committee appointed to select candidates for the Chair of Embryology at the College of France. M. Balbiani was placed first, M. Gerbe second. The election was announced for the 9th inst.