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PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

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A NEW LAW IN THERMOCHEMISTRY.

By Frank Wigglesworth Clarke,

Chief Chemist U. S. Geological Survey.

It is well understood by all who have closely considered the subject, that the so-called "heats of formation" of chemical compounds are not true physical constants, but complexes of very diverse factors. Take, for example, the heat of formation of hydriodic acid; which, when calculated from gaseous iodine, has according to Thomsen, the value of − 605 small calories. This value, however, is the algebraic sum of at least three quantities, one plus and two minus, as the following equation shows:

$$2HI - H_2 - I_2 = - 1210 \text{ calories.}$$

That is, heat is absorbed in decomposing the molecules of hydrogen and iodine, and liberated by the subsequent union of the separated atoms; the sum of the three terms being negative. The entire series of changes is endothermic; but the final step, the combination of hydrogen with iodine, must evidently be an exothermic operation.

A still more complex illustration is furnished by the formation of arsenic trichloride, $AsCl_3$. Here *solid* arsenic unites with *gaseous* chlorine, to form a *liquid* compound; and the thermal value of the transformation is affected by changes of physical state. Furthermore, heat is lost in dissociating the tetratomic molecule of arsenic and the diatomic molecule of chlorine, and evolved by the combination of these elements with each other;

the final result being the sum of at least five independent factors. These distinct quantities are not, as yet, separately measurable, their relative importance is unknown; and to many chemists, for reasons like these, the problems of thermochemistry have seemed to be hopelessly complex. Few general conclusions of unimpeachable validity have been developed by thermochemical research, and so, of late years, the entire subject has fallen somewhat into disfavor. One constant, however, has attracted almost universal attention — the neutralization constant of acids by bases — and this, having an approximate value of 13 700 calories, represents the union of hydrogen and hydroxyl ions to form water. This constant has strengthened the theory of electrolytic dissociation; and I hope now to show that it has still wider significance.

In the fourth volume of his classical *Thermochemische Untersuchungen*, Thomsen gives data relative to the heat of combustion of 118 organic compounds. These data have peculiar value, for the reason that they are strictly comparable throughout. Every substance burned was taken in the state of gas, at constant pressure, with the measurements finally reduced to a uniform temperature of 18°. The products of combustion were also gaseous, except in the case of the water, which was of course in liquid form. Upon careful scrutiny, the results obtained exhibit systematic regularities of homologous character; and this fact, which is elaborately discussed by Thomsen, tends to increase confidence in the accuracy of his data. Other observers, doubtless, have done their work equally well; but no other body of thermochemical measurements known to me is so homogeneous and so self-consistent as this one. Furthermore, Thomsen gives abundant details concerning every determination; and, as a rule, each quantity was measured several times.

In reducing his observations, Thomsen uses the socalled "heat of formation" of carbon dioxide from solid, amorphous carbon, and that of water in the liquid form. With these values, by methods which are so well known as to need no description here, he computes the heats of formation of the different compounds studied; but always on the supposition that the reactions start from the several elements in their normal molecular condition. These heats of formation are evidently not absolute, for they involve the uncertain factors due to changes of physical state; they are, therefore, as I have already shown, complexes rather than constants. Moreover, much of Thomsen's reasoning depends upon hypotheses which have been more or less questioned, so that although his conclusions are highly interesting, they have not won universal acceptance. This is especially true with respect to the thermal significance of single, double and triple unions between atoms of carbon; and on this subject Thomsen's views have met with a good deal of criticism. Nevertheless, he points out many remarkable and striking thermochemical relations, though their full meaning is yet to be elucidated.

In one respect, Thomsen's data, as he has given them, are imperfectly suited to discussion. Although he starts each combustion with gas and ends partly with gas, the water produced is always in the liquid condition. For the best consideration, the process should deal with gases throughout, both for substance and for products; then only can extraneous physical disturbances be practically eliminated, and the chemical part of the phenomenon be studied with the fewest complications. Fortunately, the obvious correction can be easily applied, at least approximately; and when that is done a new order of regularities appears.

According to Thomsen[1] the heat of formation of one gramme molecule of liquid water from its elements at 18°, is 68357 calories. For gaseous water the value varies with temperature, and may be represented at 100° by the quantity 58069. At 18° — the standard temperature of the experiments — this figure reduces to 57934. The difference in heat of formation between gaseous and liquid water, then, is 10423 calories; and this quantity should be subtracted from the heat of combustion of any organic substance as many times as there are molecules of water produced. Thus, for the heat of combustion of methane, CH_4, Thomsen gives 211930 calories. Two molecules of water are formed; we subtract, therefore, twice 10423, and the value for gaseous substances throughout becomes 191084. One gramme molecule of methane burning as gas, and with all

[1] Therm. Unt., vol. II, pp. 52–56.

products of combustion gaseous, gives 191 084 calories. In this way I have adjusted Thomsen's data; and in their new form they become the basis of my own calculations.

With values thus reduced, we may now write equations which shall represent, in thermochemical terms, the process of combustion of any organic substance which, upon burning, undergoes complete dissociation. Any hydrocarbon, for example, when burnt to form carbon dioxide and water, must have its atoms completely torn apart before they can combine with similarly dissociated atoms of oxygen. Now let x represent the *absolute* molecular heat of formation of CO_2; y the absolute heat of formation of water; z the heat lost by the dissociation of one oxygen molecule, and r the heat lost by the decomposition of the substance burned; then for CH_4 the equation becomes

$$x + 2y - 2z - r = 191\,084.$$

This is a simple case, in other instances the equations must be doubled, or in the study of some organic halides and nitrogen compounds, quadrupled, in order to avoid fractional molecules of oxygen, of nitrogen, or of a halogen element. For the sake of uniformity, then, I prefer to write quadrupled equations throughout; and the formula for the combustion of methane becomes

$$4x + 8y - 8z - 4r = 764\,336.$$

Unfortunately, equations of this kind are indeterminate, for every new formula introduces a new quantity, and so the unknowns are always in excess. A direct algebraic solution is therefore impossible, and at first sight it would seem as if the entire system of equations was valueless. That this impression is incorrect I shall endeavor to show. On careful examination the equations exhibit regularities which suggest various hypotheses; upon the latter, trials can be based, and in that way common factors are discoverable which satisfy the formulæ in a fairly definite manner. By long study and various trials of this kind I have obtained a general formula of curious significance, at least with respect to the aliphatic hydrocarbons and their non-oxygenated derivatives. It is constructed as follows:

Let K represent the heat of combustion of any one of these hydrocarbons; then in the quadrupled equations $4K$ must be taken. Now let a be the number of CO_2 molecules produced; b the number of molecules of gaseous H_2O; c the number of oxygen molecules dissociated during combustion, and n the number of atomic unions or linkings in the *single* molecule of the compound burned. Then taking these data directly from the quadrupled equation, we have the subjoined expression:

$$\frac{4K}{12a + 6b - c - 8n} = \text{constant}.$$

The two plus quantities in the divisor represent combinations; the two minus quantities stand for decompositions, and all the terms of the fundamental equations are thus utilized.

Let us apply this formula to the methane equation:

$$4x + 8y - 8z - 4r = 764336 = 4K.$$

Here $a = 4$, $b = 8$, $c = 8$ and $n = 4$, the last factor indicating the four unions of hydrogen atoms with carbon in the symbol CH_4. In ethane $n = 7$, in propane 10, etc.; all linkings, whether of hydrogen with carbon, or carbon with carbon, being treated as thermally equal. Now $12a + 6b - c - 8n = 56$, which is the divisor applicable to methane. The quotient obtained is 13 649, and this quantity I have indicated as a constant. In the following table for fourteen aliphatic hydrocarbons its constant char-

Compound.	Formula.	$4K$.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Methane	CH_4	847720	764336	56	13649
Ethane	C_2H_6	1481760	1356684	98	13844
Propane	C_3H_8	2116848	1950080	140	13929
Trimethyl methane	C_4H_{10}	2748760	2540300	182	13957
Tetramethyl methane	C_5H_{12}	3388440	3138288	224	14010
Diisopropyl	C_6H_{14}	3996800	3704956	266	13928
Ethylene	C_2H_4	1333400	1250016	92	13587
Propylene	C_3H_6	1970960	1845884	134	13776
Isobutylene	C_4H_8	2602480	2435712	176	13839
Isoamylene	C_5H_{10}	3230520	3022060	218	13862
Acetylene	C_2H_2	1240200	1198508	86	13936
Allylene	C_3H_4	1870200	1786816	128	13959
Diallyl	C_6H_{10}	3731280	3522820	254	13869
Dipropargyl	C_6H_6	3531520	3406444	242	14076
					Mean, 13873

acter appears. All the computations rest upon Thomsen's data, adjusted in the manner already described. In fixing the value of n, actual atomic unions only are counted; double or triple carbon bonds are reckoned as one alone, the extra bonds being in abeyance and thermally inoperative. In C_2H_2, for instance, $n = 3$; in ethylene, $n = 5$; and in dipropargyl $n = 11$. In all chain molecules, therefore, n equals the number of atoms in the compound less one. The fundamental fact throughout is the union of an atom with an atom, the mode of combination, the structure, being an entirely subordinate affair.

To trimethylene, C_3H_6, if it be regarded as a ring compound with nine unions in the molecule, the formula does not apply. As measured by Thomsen, its heat of combustion, per gramme-molecule, is 499430 calories. Adjusted to water as gas, this becomes 468151, and $4K = 1872604$. Then, if $n = 9$, the quotient is 14857, a quantity considerably too high. With $n = 8$, as in the case of propylene, the value of the constant is 13985, a result more in harmony with the others. According to Berthelot and Matignon[1] the heat of combustion of trimethylene at constant volume is 505600 calories; a determination still higher than that of Thomsen, and therefore still less satisfactory. This compound, then, is exceptional, and its thermal significance is yet to be interpreted. As for the aromatic hydrocarbons, they require a modified formula, and will receive separate consideration later.

Berthelot and Matignon also give data for several other of the hydrocarbons studied by Thomsen, and these may well be included here for sake of comparison. They all refer to gases at constant volume; and with them we may include two earlier measurements by Berthelot,[2] relative to methane and acetylene. Taking the *quadrupled* heats of combustion, we now have the figures given in the following table. The agreement with Thomsen is fairly good, except for the last two compounds. The difference between the quantities measured at constant pressure and those which represent constant volume, is evidently not large.

[1] Ann. Chim. Phys. (6), 30, 547.
[2] Ann. Chim. Phys. (5), 23, 178 and 180.

Compound.	4K.		Divisor.	Quotient.
	H_2O Liquid.	H_2O Gas.		
Methane	849600	766216	56	13683
Ethane	1483600	1358524	98	13863
Propane	2106800	1940032	140	13786
Ethylene	1359600	1276216	92	13872
Propylene	1991600	1866524	134	13929
Acetylene	1259600	1217908	86	14161
Allylene	1889600	1806216	128	14111

The organic halides, sulphides, and nitrogen compounds are well covered by the general formula, provided that in each case an appropriate factor be added to the divisor to indicate the halogen, sulphur dioxide, or nitrogen produced during combustion. Thus, for complete combustion of the halides, when free halogen molecules, not halogen acids, are formed, the modification of the formula is as follows: Let h represent the number of chlorine molecules produced, h_1 the bromine molecules, and h_2 the iodine; then —

For hydrocarbons, $\dfrac{4K}{12a + 6b - c - 8n}$ = constant.

For chlorides, $\dfrac{4K}{12a + 6b + h - c - 8n}$ = constant.

For bromides, $\dfrac{4K}{12a + 6b + 2h_1 - c - 8n}$ = constant.

For iodides, $\dfrac{4K}{12a + 6b + 4h_2 - c - 8n}$ = constant.

The fundamental identity of the four expressions is obvious.

Thomsen gives data for twenty-two of these compounds, and only three of them are exceptional. Chlorobenzene is an aromatic body, and, like the corresponding hydrocarbons, demands a special formula, which will be considered in due time. Carbonyl chloride is not completely dissociated upon burning, and to it, therefore, the general formula is inappropriate. The remaining exception is carbon tetrachloride, and to this substance we will recur presently. The nineteen compounds to which the formula does apply are given in the following table. In each case n represents the number of atoms in the *single* molecule, minus one.

Compound.	Formula.	$4K$. H₂O Liquid.	$4K$. H₂O Gas.	Divisor.	Quotient.
Methyl chloride	CH_3Cl	707800	645262	47	13729
Ethyl chloride	C_2H_5Cl	1336440	1232210	89	13845
Propyl chloride	C_3H_7Cl	1969520	1823598	131	13921
Isobutyl chloride	C_4H_9Cl	2600360	2412746	173	13947
Chlorethylene	C_2H_3Cl	1193360	1130722	83	13617
Chloropropylene	C_3H_5Cl	1813480	1709250	125	13674
Allyl chloride	C_3H_5Cl	1818720	1714490	125	13716
Ethylene chloride	$C_2H_4Cl_2$	1185440	1102056	80	13766
Ethylidene chloride	$C_2H_4Cl_2$	1185640	1102256	80	13778
Chloracetol	$C_3H_6Cl_2$	1815520	1690444	122	13840
Chloroform	$CHCl_3$	428120	407274	29	14044
Chlorethylene chloride	$C_2H_3Cl_3$	1049920	987382	71	13907
Tetrachlorethylene	C_2Cl_4	780280	780280	56	13934
Methyl bromide	CH_3Br	738840	676302	49	13802
Ethyl bromide	C_2H_5Br	1367280	1263050	91	13880
Propyl bromide	C_3H_7Br	1997160	1851238	133	13919
Allyl bromide	C_3H_5Br	1848480	1744250	127	13734
Methyl iodide	CH_3I	784320	721782	53	13619
Ethyl iodide	C_2H_5I	1414920	1310690	95	13797
					Mean, 13815

For carbon tetrachloride the heat of combustion, as given by Thomsen, is 75 930 calories. Hence $4K = 303\,720$. Applying the proper divisor to this quantity, we have a quotient of 15 186, a value far too high. The actual measurements, however, were made by a complex process, and may well be somewhat uncertain. Farther investigation is necessary in the case of carbon tetrachloride, since this one possible failure of the formula cannot counterbalance its nineteen successful applications.

What, now, is the meaning of the formula, and of the constant which is evidently derived from it? A consideration of this question may conveniently precede the discussion of other thermochemical quantities. First, however, I may call attention to the fact that the formula itself can be condensed and simplified. Taking the hydrocarbons as the least complex of the compounds we have studied, the expression for them may be given in three forms, thus:

$$\frac{4K}{12a + 6b - c - 8n} = \frac{4K}{11\left(a + \frac{b}{2}\right) - 8n} = \frac{4K}{11c - 8n} = \text{constant.}$$

The difference between these expressions arises from the fact that the oxygen consumed is always proportional to the carbon and hydrogen burned; but the divisor in all three formulæ has the same value and gives the same quotient. The first and most elaborate form is the one to be preferred, for the reason that it gives in detail all the terms of the original equations. In it the constant appears as a function of all the changes which have taken place; the substances produced being indicated with the plus sign, while the substances destroyed are minus. The other formulæ may be easier to apply, but they are much less simple to interpret.

In the thirty-three compounds so far tabulated, the mean value of the quotient is 13 828 calories. This is sensibly identical in magnitude, within the limits of experimental uncertainty, with the neutralization constant, which is commonly put at 13 700 calories, with actual measurements ranging from 13 600 to 13 900. The latter is purely chemical in its origin, uncomplicated by extraneous physical considerations; and it represents the thermal value of the simplest of all unions, one bond joining two ions. In short, it seems to be a definite unit of thermochemical change, of which the quantities discussed in this paper are multiples, and by whose aid the original equations, hitherto indeterminate, may be satisfied. Let us examine the general formula a little more closely and in detail.

If now we take the constant, instead of the calorie, as our unit, the fundamental formula may be written

$$\frac{4K}{12a + 6b - c - 8n} = 1, \text{ or one unit,}$$

and hence, $12a + 6b - c - 8n = 4K$. That is, each molecule of a or CO_2 produced by a combustion has a value of 12 units. Each molecule of water is represented by 6 units, each molecule of oxygen by 1, and each atomic linking in a single molecule of the substance under investigation by $\frac{8}{4}$ or 2 units. These quantities represent the actual heat of formation of the several molecules from gaseous, dissociated atoms; and when they are introduced into the original equations, the latter are satisfied. The final value of the constant, which, for convenience, we may call the *Henotherm*,[1] cannot be fixed until we have completed

[1] The prefix *heno* is from the Greek verb ἑνόω, to unite.

our study of all the available data, but we may for present purposes assign to it the rounded-off magnitude of 13 700 calories, which is close enough for preliminary application. This is the commonly accepted value of the neutralization constant.

Let us now recur to the typical equation for methane,

$$x + 2y - 2z - r = 191\,084 \text{ calories},$$

and analyze it in terms of henotherms.

$$\begin{aligned} x &= 12 \text{ henotherms.} \\ 2y &= 6 \times 2 \text{ henotherms.} \\ -2z &= -2 \text{ henotherms.} \\ -r &= -8 \text{ henotherms.} \\ \hline \text{Sum} &= 14 \text{ henotherms} = 191\,800 \text{ calories.} \end{aligned}$$

This quantity exceeds Thomsen's average, as given above, by only 0.37 per cent. But Thomsen's separate determinations vary among themselves by 0.99 per cent., so that the agreement between measurement and calculation is most satisfactory. The Berthelot value, as already cited, is even closer, being, for gaseous substances throughout, 191 554 calories. Other comparisons between observation and theory will be given later in this memoir, when the magnitude of the henotherm shall have been more definitely fixed. Meanwhile, we may take the following *absolute* heats of combination as approximately established, in order that we may apply them to future use:

O=O,	1	henotherm	= 13700	calories.
Cl—Cl,	1	"	= 13700	"
Br—Br,	2	"	= 27400	"
I—I,	4	"	= 54800	"
H—O—H,	6	"	= 82200	"
O=C=O,	12	"	= 164400	"

These follow from the general formula in the manner already indicated; but they differ in some respects from the estimates of previous computers. Thus Thomsen[1] finds, for the heat of combustion of an isolated carbon atom, the value 135 340 calo-

[1] Therm. Unt., vol. IV, pp. 257–260.

ries. By comparing this with the directly measured *apparent* heat of combustion of amorphous carbon, 96 960 calories, he deduces that the difference between the two quantities, 38 380 calories, represents the heat absorbed in gasifying and dissociating the solid elementary molecule. If, however, the *absolute* heat of formation of carbon dioxide is assigned the higher value as shown above, then the corresponding difference between it and the ordinary or apparent heat is 67 440 calories, or very nearly five henotherms. From this we must deduct the heat expended in the dissociation of one oxygen molecule, or 13 700 calories, leaving 53 740 as due to the volatilization and isolation of one carbon atom. Four henotherms equal 54 800 calories approximately, a quantity which seems more probable than the surprisingly small estimate made by Thomsen.

Again, the absolute heat of formation which I have assigned to the iodine molecule is practically double the value calculated by Boltzmann[2] from the dissociation phenomena of the element. The reasons for these and other similar differences I shall not attempt to trace; but additional evidence will in due time be presented in favor of the new values.

We have already seen that the magnitude of n in the general formula is equal to two henotherms, or about 27 400 calories, for each atomic linking. I must also reiterate that every such linking counts for one only, regardless of double or triple bonds. In other words — *the absolute heat of formation of an aliphatic hydrocarbon, or of its halogen derivative, is proportional to the number of atomic unions in the molecule, and seems to bear no relation to the masses of the atoms combined.* Hydrocarbons, chlorides, bromides and iodides all follow the same rule; and in it we have a first glimpse of something like a true general law. By applying the values already given to CO_2, H_2O, O_2, Cl_2, Br_2 and I_2 to the evaluation of r in the fundamental equations of combustion, we can test this principle, and see how far the facts support the theory. Thus, in all of the following compounds $n = 4$, and hence, in each case, the absolute heat of formation should be $4 \times 27\,400$, or 109 600 calories. By evaluating r in the equations we get the following results.

[2] Wiedemann's Annalen (2), 22, 71.

Methane,	CH_4	$r = 110316$	calories.
Methyl chloride,	CH_3Cl	$r = 109259$	"
Chloroform,	$CHCl_3$	$r = 107107$	"
Methyl bromide,	$CHBr_3$	$r = 108849$	"
Methyl iodide,	CHI_3	$r = 110680$	"
Carbon tetrachloride,	CCl_4	$r = 102170$	"
Mean,		$r = 108063$	"
Rejecting CCl_4,		$r = 109242$	"

The values are near together, and when we remember that all the errors of each determination are accumulated in this one final difference, the agreement is surprisingly good. The one bad item in the table is the case of carbon tetrachloride, and this has already been noted as questionable.

The rule, then, for the thirty-three compounds now under consideration, is simple. *To find the absolute heat of formation of any compound in this group, multiply the number of atomic unions in its molecule by 27 400 calories, and the product is the value desired.* The factor 27 400, of course, is subject to some adjustment later, as the magnitude of the henotherm becomes better known. For other series of compounds other fundamental constants hold, as we see already in the estimates for carbon dioxide and water. This question need not be considered any more fully just now.

One other application of the law now before us is worth noting, although the requisite data relate, not to gases, but to solutions. Many organic compounds unite directly with bromine to form addition products, heat being evolved. Each bromine atom taken up means one more atomic linking, and therefore a liberation of 27 400 calories. On the other hand, each bromine molecule requires 27 400 calories for its dissociation. When Br_2 acts upon an olefine, then, 27 400 calories are lost, and twice 27 400 are evolved. The gain in heat, therefore, should be 27 400 calories. The following data by Louguinine and Kablukoff[1] will serve to illustrate this relation. The reactions were effected upon substances dissolved in carbon tetrachloride. I include with these measurements the evidence in the case of ethylene, as determined by Berthelot,[2] who employed gaseous substances.

[1] Compt. Rend., 116, 1197, and 124, 1303.

[2] Essai de Mec. Chim., 1, 343.

Compound Brominated.	Product.	Calories Developed.
Ethylene (Berthelot)	$C_2H_4Br_2$	27200
Trimethylethylene	$C_5H_{10}Br_2$	27285
Hexylene	$C_6H_{12}Br_2$	28843
Diallyl	$C_6H_{10}Br_4$	2×28057
Allyl alcohol	$C_3H_6OBr_2$	27732
Allyl bromide	$C_3H_5Br_3$	26695
Allyl chloride	$C_3H_5ClBr_2$	26821
Ethyl allyl ether	$C_5H_{10}OBr_2$	28133
Allyl acetate	$C_5H_8O_2Br_2$	27017

So far the agreement with theory is remarkable, but there are three exceptions to be noted. The formulæ relate to the products of the reactions.

Crotonic aldehyde,	$C_4H_6OBr_2$	19349
Mesityl oxide,	$C_6H_{10}OBr_2$	20238
Cinnamic alcohol,	$C_9H_{10}OBr_2$	22321

Whatever these exceptions may mean, it is clear that the rule holds in nine cases out of twelve, giving an average value for the henotherm of one half of 27 530, or 13 765, and this agrees with the values so far derived from other sources.

In order to test our general formula still farther, let us apply it to the organic compounds of nitrogen. Beginning with the amines, for which Thomsen gives adequate data, we have equations of this type, in which w represents the heat of formation of the molecule of nitrogen. For ethylamine, $C_2H_5.H_2N$ the quadrupled formula is $C_8H_{28}N_4$, giving

$$8x + 14y + 2w - 15z - 4r = 1\,516\,758 \text{ calories},$$

when all the substances are gaseous. The derived formula is exactly the same as that for the hydrocarbons, except that a factor for nitrogen must be introduced, and this when m represents the number of nitrogen molecules produced, is $9\,m$. The formula thus becomes

$$\frac{4K}{12a + 6b + 9m - c - 8n} = \text{constant},$$

and from this we find that nine henotherms, or 123 300 calories, is the heat of formation of N_2. This very high value corresponds well with the known stability and inertness of nitrogen. The table for ten aliphatic amines, with the constant yielded by the formula, is as follows:

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Methylamine	CH_5N	1033280	929050	69	13465
Ethylamine	C_2H_7N	1662680	1516758	111	13664
Propylamine	C_3H_9N	2302960	2115346	153	13826
Isobutylamine	$C_4H_{11}N$	2901440	2672134	195	13703
Amylamine	$C_5H_{13}N$	3562320	3291322	237	13887
Dimethylamine	C_2H_7N	1681840	1535918	111	13837
Diethylamine	$C_4H_{11}N$	2938000	2708694	195	13891
Trimethylamine	C_3H_9N	2330520	2142906	153	14006
Triethylamine	$C_6H_{15}N$	4209520	3896830	279	13967
Allylamine	C_3H_7N	2125120	1979198	147	13463
				Mean,	13771

Aniline, pyridine and piperidine, being ring compounds, will be considered later. For ammonia, as measured by Thomsen, the heat of combustion is 90 650 calories, or 75 011 with the water gaseous. Hence $4K = 300\,044$. The proper divisor is 27, which gives a quotient of 11 113, a wide departure from the rule. To ammonia, therefore, the formula fails to apply. Whether the error is in the observation or the theory, remains to be determined. The ten amines, however, seem to be perfectly regular.

We have now studied forty-three compounds, or fifty-two if we include the bromination series of Louguinine and Kablukoff, which seem to obey the new general law. Each one gives an absolute heat of formation proportional to the number of atomic unions in its molecule, and each union has the thermal value of two henotherms. The latter uniformity of value, however, does not hold universally, and some exceptions to it are already evident. For instance, the absolute heat of formation assigned to carbon dioxide is twelve henotherms, or six for each of its two atomic linkings, a quantity three times as large as the normal. We may suppose, therefore, that different series of compounds may have different fundamental values, and also that mixed series may occur. This appears to be the case with the few gaseous cyanogen compounds investigated by Thomsen, for which the formula must be modified.

If to these compounds, four in number, we apply the formula which was satisfactory with the amines, we shall obtain quotients which are from one to two thousand calories below the nenotherm. If, however, we subtract from the divisor of the formula six units for each molecule of nitrogen set free during combustion, the results will be more satisfactory, as follows:

Compound.	Formula.	$4K$.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Hydrocyanic acid	CNH	634480	613634	45	13636
Cyanogen	C_2N_2	1038480	1038480	76	13664
Acetonitrile	C_2H_3N	1248560	1186022	87	13632
Propionitrile	C_3H_5N	1885800	1781570	129	13811
					Mean, 13686

That is, by a constant correction to the usual formula the regular constant can be made to appear, although at first sight the procedure seems to be arbitrary. That the correction has definite significance, however, can be easily shown.

The quadrupled equations for these compounds are, when all substances are gaseous,

For CNH, $4x + 2y + 2w - 5z - 4r = 613634$
For C_2N_2, $8x + 4w - 8z - 4r = 1038480$
For C_2H_3N, $8x + 6y + 2w - 11z - 4r = 1186022$
For C_3H_5N, $12x + 10y + 2w - 17z - 4r = 1781570$

Now, using the assigned values for x, y, z, and w we can evaluate r, and so obtain the subjoined figures:

Hydrocyanic acid,	$r = 96614$ calories.	7 henotherms	=	95900
Cyanogen,	$r = 165080$ "	12 "	=	164400
Acetonitrile,	$r = 179569$ "	13 "	=	178100
Propionitrile,	$r = 256732$ "	19 "	=	260300

These quantities are not simply and directly proportional to the number of atomic linkings in the several molecules, and still a regularity exists of an order hitherto unnoted in this memoir. The unions C — C, C — H, etc., in the series so far studied, have each the value of two henotherms, and so also has the union C — N in the amines. But the union C — N in the cyanides has a different value, apparently of five henotherms, and when that is taken into account the quantities in the foregoing table become rational. Thus in CNH there are two atomic unions, one of two and one of five henotherms, and the sum is seven henotherms, the quantity found. In C_3H_5N there are seven ordinary unions and one of the cyanogen type, $(7 \times 2) + 5 = 19$.

Cyanogen itself gives $2 + (5 \times 2) = 12$, and acetonitrile has $(4 \times 2) + 5 = 13$. Nitrogen, then, in its combinations with carbon, must be assigned at least two thermal values, but these are still multiples of the henotherm, the fundamental quantity. Possibly the differences may discriminate between quinquivalent and trivalent nitrogen, although the data are too few to settle this point definitely.

In the combustion of organic sulphur compounds, at least in the examples given by Thomsen, SO_2 is produced, and this implies a distinct factor in the divisor of the general formula. If s represents the number of molecules of SO_2 formed, the factor to be added is $9s$, and the formula becomes

$$\frac{4K}{12a + 6b + 9s - c - 8n} = \text{constant}.$$

From this expression the absolute heat of formation of SO_2 from isolated atoms of sulphur and oxygen is nine henotherms, or 123 300 calories; while the ordinary value, as derived from the normal molecular elements, is 71 000. Add to the latter the 13 700 calories due to the dissociation of oxygen, and the sum is approximately six henotherms, leaving three henotherms ascribable to the gasification and isolation of one sulphur atom.

Three of the compounds studied by Thomsen contained the cyanogen group, and for these the divisor of the general formula must be modified exactly as was done with the other cyanides. So much assumed, the formula can be applied as follows:

Compound.	Formula.	$4K$.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Hydrogen sulphide.....	H_2S	546840	505148	38	13293
Methyl mercaptan......	CH_4S	1195240	1111856	80	13898
Ethyl mercaptan........	C_2H_6S	1822600	1697524	122	13914
Methyl sulphide.........	C_2H_6S	1829400*	1704324	122	13970
Ethyl sulphide...........	$C_4H_{10}S$	3088680	2880220	206	13981
Methyl sulphocyanide.	C_2H_3NS	1595800	1533262	111	13813
Methyl mustard oil.....	C_2H_3NS	1568240	1505702	111	13565
Allyl mustard oil........	C_4H_5NS	2701440	2597210	189	13742
				Mean,	13773

There are three other sulphur compounds in Thomsen's list, to which the formula does not apply. Thiophene is a ring compound, and will be studied with other bodies of like constitution. Carbonyl sulphide contains oxygen, and is therefore incompletely dissociated when burned. Carbon disulphide, like the dioxide, belongs in a different class, and must be considered separately. According to Thomsen, its heat of combustion is 265 130 calories, all substances being gaseous. Hence, if t represents the absolute heat of formation of SO_2, its equation of combustion is

$$x + 2t - 3z - r = 265130,$$

and therefore $r = 104\,770$ calories approximately, or between seven and eight henotherms. A small change in the value of the henotherm would bring the result near the higher figure, which is probably the one to choose. But new measurements are needed to settle this question.

There still remain to be examined, in addition to the aromatic compounds and the carbonyl derivatives, something like fifty other substances which contain, in addition to carbon and hydrogen, more or less oxygen within their molecules. They are, therefore, upon burning, incompletely dissociated; for the oxygen atoms must remain combined with one or another of the elements associated with them. Furthermore, fewer oxygen molecules are broken up during combustion, and this fact affects the number c of the general formula. The latter, however, still applies, and the same constant appears as its quotient. In all cases c represents the number of oxygen molecules which are decomposed; but among the compounds hitherto studied it also stands for all the oxygen needed to satisfy the carbon, the hydrogen or the sulphur of the substance burned.

In the large group of bodies now to be considered, oxygen may exercise any one of three distinct functions. It may link carbon with carbon, as in the structure $\equiv C - O - C \equiv$; it may stand between carbon and hydrogen, in the form $\equiv C - O - H$; or it may be wholly united with carbon in the group $= C = O$. In the first of these modes of combination the two unions seem to be normal, giving thermal values which correspond exactly with the hydrocarbons and their dissociable derivatives. To the ethers, then, the normal formula

$$\frac{4K}{12a + 6b - c - 8n} = \text{constant}$$

is properly applicable. Taking Thomsen's data we have the following table:

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Dimethyl ether..........	C_2H_6O	1397440	1272364	92	13830
Methyl ethyl ether......	C_3H_8O	2023480	1856712	134	13856
Diethyl ether	$C_4H_{10}O$	2638400	2429940	176	13806
Methyl allyl ether	C_4H_8O	2508800	2342032	170	13777
Diallyl ether............	$C_6H_{10}O$	3644400	3435940	248	13855
Methyl propargyl ether	C_4H_6O	2415240	2290244	164	13965
Methylal	$C_3H_8O_2$	1904220	1737552	128	13574
Methyl orthoformate...	$C_4H_{10}O_3$	2396720	2188260	164	13343
Ethylene oxide..........	C_2H_4O	1250200	1166816	86	13568
				Mean,	13730

Here the absolute heat of formation is still directly proportional to the number of atomic linkings, all of the latter being equal in value.

In the alcohols the oxygen is wholly present as hydroxyl; that is, it is connected with carbon on one side and with hydrogen upon the other. With these compounds the usual formula does not exactly hold, and a simple modification of it becomes necessary. Let c represent the external oxygen required for a combustion, and c_1 the number of oxygen molecules[1] contained in the alcohol, using quadrupled formulæ as heretofore. Then

$$\frac{4K}{12a + 6b - c - c_1 - 8n} = \text{constant,}$$

at least for this particular series of substances. The data are as given on next page. The results, on the whole, are satisfactory, and their significance is evident when they are taken in connection with previous series of computations.

In the aldehydes and ketones all of the internal oxygen is combined with carbon in the group $= C = O$; but in the acids of the paraffin series it plays a double part in the arrangement $O = C - O - H$. Nevertheless these compounds, so far as

[1] The word *molecule* as thus used is hardly exact. It is taken as equivalent to a pair of atoms, and is so employed in order to avoid circumlocution.

Thomsen's data go, conform to the one type of formula, in which instead of c_1, the factor $5c_1$ appears, thus,

$$\frac{4K}{12a + 6b - c - 5c_1 - 8n} = \text{constant.}$$

The data for nine available compounds are these; c_1 being the number of oxygen molecules or pairs of atoms contained in the quadrupled compound. Acetic anhydride approximately follows the same rule.

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Methyl alcohol	CH_4O	728920	645536	48	13448
Ethyl alcohol	C_2H_6O	1362120	1237044	90	13745
Propyl alcohol	C_3H_8O	1994520	1827752	132	13846
Isopropyl alcohol	C_3H_8O	1973280	1806512	132	13686
Isobutyl alcohol	$C_4H_{10}O$	2633960	2425550	174	13939
Trimethyl carbinol	$C_4H_{10}O$	2565360	2356900	174	13546
Isoamyl alcohol	$C_5H_{12}O$	3280280	3030128	216	14028
Dimethyl ethyl carbinol	$C_5H_{12}O$	3241800	2991648	216	13850
Allyl alcohol	C_3H_6O	1859040	1733964	126	13762
Propargyl alcohol	C_3H_4O	1724400	1641016	120	13675
Ethylene glycol	$C_2H_6O_2$	1192440	1067364	82	13017
				Mean,	13686
				Omitting ethylene glycol,	13752

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Acetic aldehyde	C_2H_4O	1127600	1044216	76	13766
Propionic aldehyde	C_3H_6O	1762880	1637804	118	13880
Isobutyric aldehyde	C_4H_8O	2399600	2232832	160	13955
Dimethyl ketone	C_3H_6O	1749000	1623924	118	13762
Methyl propyl ketone	$C_5H_{10}O$	3016760	2808300	202	13902
Formic acid	CH_2O_2	277560	235868	18	13104
Acetic acid	$C_2H_4O_2$	901400	818056	60	13634
Propionic acid	$C_3H_6O_2$	1546040	1420964	102	13931
Acetic anhydride	$C_4H_6O_3$	1840280	1715204	122	14059
				Mean,	13777

In the esters the internal oxygen has still another value, which is represented in the general formula by $4c_1$. The formula now becomes

$$\frac{4K}{12a + 6b - c - 4c_1 - 8n} = \text{constant,}$$

and the data are as given in the subjoined table:

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Methyl formate	$C_2H_4O_2$	964840	881456	64	13773
Methyl acetate	$C_3H_6O_2$	1596960	1471884	106	13886
Ethyl formate	$C_3H_6O_2$	1600240	1475164	106	13917
Methyl propionate	$C_4H_8O_2$	2215800	2049032	148	13845
Ethyl acetate	$C_4H_8O_2$	2186280	2019512	148	13645
Propyl formate	$C_4H_8O_2$	2235200	2068532	148	13976
Methyl isobutyrate	$C_5H_{10}O_2$	2867760	2659300	190	13996
Isobutyl formate	$C_5H_{10}O_2$	2879600	2671140	190	14059
Allyl formate	$C_4H_6O_2$	2111600	1986524	142	13989
Dimethyl carbonate	$C_3H_6O_3$	1430280	1305204	92	14187
Diethyl carbonate	$C_5H_{10}O_3$	2696400	2487940	176	14135
				Mean,	13946

Here the mean value is unusually high, on account of the last six compounds.

The oxy-derivatives of the aliphatic hydrocarbons, then fall into four groups as defined by the thermal effect of their internal oxygen. In the ethers this effect is normal, and c_1 can be ignored; in the other groups we have

$- c_1$ for the alcohols,

$- 4c_1$ for the esters,

$- 5c_1$ for aldehydes, ketones and acids.

The esters, it should be observed, are intermediate between the alcohols and the acids, and the coefficient of c_1 indicates this peculiarity. The different structural relations of the oxygen atoms are also suggested in these values, but not rigorously; for in a single compound this element may exercise two distinct functions, which the foregoing coefficients do not clearly show.

Unfortunately we cannot, for these compounds, write complete equations of combustion in the sense in which we have written them hitherto. In the typical equation for methane the symbol $-r$ represents the total heat of dissociation, or of formation when the plus sign is used. In a similar equation for methyl alcohol it can only stand for partial dissociation, and its meaning is therefore distinctly changed. Hence, in the equations for this class of substances we are unable to directly evaluate the absolute heats of formation. To estimate these we must apply the corrections which are indicated by the different coefficients of c_1, the latter, like other similar coefficients, having been determined by trial, empirically. Now, in the general formula, $-c_1$ means one henotherm, $-4c_1$ four henotherms, and $-5c_1$ five henotherms, to be subtracted from the divisor for each pair of oxygen atoms contained in the substance burned. These quantities correspond to the varying thermal values of the internal oxygen, and they find their precedent in the two values which nitrogen has given us. They represent additions to the normal heats of formation of the various compounds, as determined by the rules already laid down, when all atomic unions are considered as being thermally equal; but their application in detail involves uncertainties which need fuller discussion than I am now prepared to give them. As an example I may point out one difficulty, as follows:

The absolute heat of formation of water, $H - O - H$, as shown in the formulæ already developed, is six henotherms. But the neutralization reaction, $H - OH$, as interpreted by the theory of solutions, gives only one henotherm. Hence it would seem as if the formation of hydroxyl, supposing that it could be isolated, would develop five henotherms. Now consider methyl alcohol, $CH_3 - OH$. The three hydrogen unions with carbon are doubtless normal, and equal to two henotherms each; but what values have the other bonds in the compound? If normal, they also should liberate two henotherms apiece, but if they follow the analogies suggested by water, they ought to give one plus five, or six henotherms, making, with the methyl group, twelve in all. The normal value for methyl alcohol is ten; the actual value is certainly higher, but the amount and distribution of the excess are in doubt. If, from the coefficient of c_1 we infer that the increase is *one*, then the true heat of formation of methyl alcohol should be eleven henotherms. On this supposition we should have four unions giving the usual two henotherms each, and one, the hydroxyl union, giving three. The latter quantity is exactly half the absolute heat of formation of water, and its assumption satisfies most of the conditions of the problem. At all events, whenever hydroxyl is present in an organic compound, the heat of combustion is modified by a quantity which is represented by c_1 in the general formula for the development of the constant; and the simplest explanation of the fact is the one which I have just given. In the phenomena of neutralization we have a reaction between separated ions, and the forces which hold the latter in equilibrium come into play. Hence the ionic combination H — OH and the atomic unions in H — O — H are not necessarily the same, although one fundamental constant seems to govern both operations. The only definite conclusion to be reached at present is, that the heats of formation of the oxygen compounds usually exceed the normal, by differences which are constant for each class.

Among the organic compounds containing both oxygen and nitrogen, Thomsen gives only six examples, and these are not altogether satisfactory. They respond, approximately, to the formula used for the amines; but this involves the unproved assumption that the substances, during combustion, dissociate completely; in other words, that the internal oxygen is ignored. The data are given below, when

$$\frac{4K}{12a + 6b + 9m - c - 8n} = \text{constant.}$$

Compound.	Formula.	4*K*.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Ethyl nitrate	$C_2H_5NO_3$	1296160	1191930	87	13700
Ethyl nitrite	$C_2H_5NO_2$	1336840	1232610	93	13254
Isobutyl nitrite	$C_4H_9NO_2$	2590640	2403026	177	13578
Amyl nitrite	$C_5H_{11}NO_2$	3250560	3021252	219	13796
Nitromethane	CH_3NO_2	723600	661062	51	12962
Nitroethane	$C_2H_5NO_2$	1351760	1247528	93	13414
				Mean,	13474

The questionable character of this mean is evident, although two of the quotients are good. For this class of substances more data are necessary, with a more elaborate discussion than is now practicable.

Up to this point we have considered only linear molecules, that is, molecules whose atoms are united in such a manner as to form the so-called chains. The ring compounds, which are mainly of the aromatic series, remain to be examined. In the first group of substances *n* represents the number of atoms in the molecule less one. In the ring structure, if we ignore double bonds, n is equal to or greater than the number of atoms. Thus in benzene, C_6H_6, n is at least 12, whereas in its isomer, dipropargyl, $n = 11$. If now we provisionally assume that in the aromatic compounds the number of linkings and the number of atoms are equal, we shall find that the regular formula applies to them also, provided that a constant correction be applied. This correction in the quadrupled equation, is -12, and the general formula for the aromatic hydrocarbons becomes

$$\frac{4K}{12a + 6b - c - 8n - 12} = \text{constant.}$$

For other compounds, like phenol, chlorobenzene, aniline, etc., other factors must be included, exactly as in the previous series. These factors, h, $9m$, $-c_1$, $9s$, etc., have already been adequately explained. The data, all due to Thomsen, are as follows, with the results of computation added:

Compound.	Formula.	4K.		Divisor.	Quotient.
		H_2O Liquid.	H_2O Gas.		
Benzene	C_6H_6	3151800	3026724	222	13634
Toluene	C_7H_8	3822720	3655982	264	13812
Mesitylene	C_9H_{12}	5129240	4879082	348	14020
Pseudocumene	C_9H_{12}	5126040	4875888	348	14011
Chlorobenzene	C_6H_5Cl	3055520	2151290	213	13856
Phenol	C_6H_6O	3075040	2949964	214	13785
Anisol	C_7H_8O	2745200	3578432	258	13884
Aniline	C_6H_7N	3353880	3207958	235	13651
Pyridine	C_5H_5N	2700282	2596050	193	13451
Thiophene	C_4H_4S	2442560	2359176	172	13716
				Mean,	13782

For benzene I have taken Thomsen's older determination,[1] which gives the heat of combustion as 787950 calories. His later determination[2] of 799280 has been shown by Stohmann and by Berthelot to be too high. Their measurements agree with the lower value. The higher figure probably owes its excess to extraneous heat derived from the use of Thomsen's "universal burner."

[1] Therm. Unt., II, 95.

[2] *Ibid.*, IV, 59.

What now, does the correction — 12 mean? If we write the equations of combustion for the several compounds and evaluate r, we shall find in every case that the absolute heat of formation, in henotherms, is $2n + 3$. Thus for benzene, if $n = 12$, we have $2n = 24$, and $2n + 3 = 27$. This constant increase undoubtedly is connected with the structure of the aromatic ring, and may be interpreted in either of two ways. Either the three double bonds of the Kekulé ring have higher thermal values than usual, being three henotherms instead of two henotherms each, or else there are three cross linkings, as in the centric formula, thermally equal to one henotherm apiece. The first explanation is negatived by the evidence regarding double and triple bonds which is furnished by the aliphatic compounds; the centric explanation, therefore, seems to be the more probable. The latter, however, is difficult to apply in the case of thiophene, and so, for the time being, the question must be left open.

In piperidine, $C_5H_{11}N$, we have a seemingly exceptional compound. The heat of combustion is given by Thomsen as 883 790 calories. For gaseous substances throughout this becomes 777 464, and $4K = 3\,105\,856$. The divisor, with the correction of — 12 applied is 211, and hence the quotient is 14 720. If, however, we neglect the correction, and accept 223 as the normal divisor, we have a quotient of 13 927, which is in harmony with the other regular values. That is, piperidine, regarded as pyridine hexhydride, has no double bonds nor cross linkings, and it responds to the general formula exactly like the amines. If we include its normal quotient with the others of the aromatic group, the mean of all the eleven compounds becomes 13 795. This mean will be adopted in the final summation.

Three compounds still remain to be studied, and these form a group by themselves. They are carbon monoxide, CO, carbonyl chloride, $COCl_2$, and carbonyl sulphide, COS. Since they contain oxygen, they are only in part dissociated when burned, and their thermal interpretation is, therefore, difficult. Their heats of combustion, as given by Thomsen, are as follows:

CO	67960 calories.	5	henotherms	= 68500
$COCl_2$	41820 "	3	"	= 41000
COS	131010 "	9½	"	= 130150

These quantities do not seem to bear any simple relation to the formulæ developed in this paper, but it is noticeable that two of them approximate very closely to exact multiples of our constant. This agreement is probably not accidental, but its significance is not clear. I shall therefore, put these substances in the class of exceptions, and leave them, with other outstanding difficulties, uninterpreted.

So far, in our comparisons of fact with theory, we have assigned to the henotherm a provisional value of 13 700 calories. Let us now sum up the values actually obtained, and compute their general mean.

Aliphatic hydrocarbons	14 compounds.	Mean	13873
Aliphatic halides	19 "	"	13815
Bromination series[1]	9 "	"	13765
Aliphatic amines	10 "	"	13771
Cyanogen compounds	4 "	"	13686
Sulphur compounds	8 "	"	13773
Ethers	9 "	"	13730
Alcohols	11 "	"	13686
Aldehydes, ketones and acids	9 "	"	13777
Esters	11 "	"	13946
Nitrates, nitrites, etc	6 "	"	13474
Aromatic compounds	11 "	"	13795
General mean for 121 compounds			13777

The data for 112 of these substances are due to Thomsen, and only seven of the organic compounds studied by him are not covered by the formula. They are trimethylene, carbonyl chloride, carbon tetrachloride, ammonia, carbonyl sulphide, carbon disulphide and carbon monoxide. The evidence establishing the constant seems to be overwhelming.[2]

Before passing on to the discussion of other data, and of the law which I have sought to define, it may be well to tabulate Thomsen's measurements, side by side with the calculated values. The latter are simply the average value of the henotherm multiplied by the quantities heretofore used as divisors; but reduced from the quadrupled to the single equations. From this comparison we can compute the percentage variation between

[1] Data by Louguinine and Kablukoff.

[2] Glimpses of the same constant are given by Thomsen at several places in his great work. See vol. 3, pp. 222, 293; and vol. 4, p. 316. The existence of the constant is noted, but its significance is not shown.

observation and theory; and so form some conception of the magnitude of our uncertainties. For this purpose I make use of Thomsen's average determinations, and in each case, in a final column, give the percentage difference between his highest and his lowest result. Putting the constant at 13 777 calories, the table of comparison is as follows:

Compound.	Heat of Combustion, Thomsen.		Calculated.	Percentage Difference.	Thomsen's Variation.
	H_2O Liquid.	H_2O Gas.			
Methane	211930	191084	192878	+0.94	0.99
Ethane	370440	339171	337536	—0.49	1.13
Propane	529210	487518	482195	—1.10	0.84
Trimethylmethane	687190	635075	626854	—1.31	0.38
Tetramethylmethane	847110	784562	771512	—1.69	0.17
Diisopropyl	999200	926259	916170	—1.10	0.28
Ethylene	333350	312504	316871	+1.39	0.49
Propylene	492740	461471	461529	+0.01	0.40
Isobutylene	650620	608928	606188	—0.45	0.38
Isoamylene	807630	755515	750847	—0.62	0.40
Acetylene	310050	299627	296205	—1.16	1.09
Allylene	467550	446704	440864	—1.32	0.08
Diallyl	932820	880705	874839	—0.67	0.28
Dipropargyl	882880	851611	833508	—2.18	0.55
Benzene	787950	756681	764623	+1.05	0.53
Toluene	955680	913988	909282	—0.51	0.79
Mesitylene	1282310	1219772	1198599	—1.77	0.04
Pseudocumene	1281510	1218972	1198599	—1.70	0.16
Methyl chloride	176950	161315	161879	+0.35	0.18
Ethyl chloride	334110	308052	306538	—0.49	......
Propyl chloride	492380	455899	451196	—1.04	......
Isobutyl chloride	650090	603610	595855	—1.30	......
Chlorethylene	298340	282705	285872	+1.12	0.06
Chloropropylene	453370	427312	430531	+0.75	0.35
Allyl chloride	454680	428622	430531	+0.44	......
Ethylene chloride	296360	275514	275540	+0.01	0.24
Ethylidene chloride	296410	275564	275540	—0.01	0.70
Chloracetol	453880	422611	420198	—0.58	0.22
Chloroform	107030	101818	99883	—1.94	2.16
Chlorethylene chloride	262480	246422	244541	—0.77	1.77
Tetrachlorethylene	195070	145070	192878	—1.14	......
Chlorobenzene	763880	737822	733625	—0.57	0.31
Methyl bromide	184710	169075	168768	—0.18	0.09
Ethyl bromide	341820	315762	313426	—0.75	0.23
Propyl bromide	499290	462809	458085	—1.03	0.01
Allyl bromide	462120	436062	437419	+0.31	0.09
Methyl iodide	196080	180445	182545	+1.16	0.02
Ethyl iodide	353730	327672	327203	—0.15	0.22
Methylamine	258320	232262	237653	+2.32	1.72
Ethylamine	415670	379189	382311	+0.82	0.73
Propylamine	575740	528836	526971	—0.35	0.08
Isobutylamine	725360	668033	671628	+0.54	0.21
Amylamine	890580	822830	816287	—0.80	0.11
Dimethylamine	420460	383979	382311	—0.44	0.50

Compound.	Heat of Combustion, Thomsen. H₂O Liquid.	Heat of Combustion, Thomsen. H₂O Gas.	Calculated.	Percentage Difference.	Thomsen's Variation.
Diethylamine	734500	677173	671628	—0.83	0.40
Trimethylamine	582630	535726	526971	—1.65	0.84
Triethylamine	1052380	974207	960945	—1.38	0.36
Allylamine	531280	494799	506304	+2.32	0.38
Aniline	838470	801989	809398	+0.92	0.11
Pyridine	675070	649012	664740	+2.42	0.10
Piperidine	833790	776463	768067	—1.09	0.45
Hydrocyanic acid	158620	153408	154991	+1.03	0.55
Cyanogen	259620	259620	261763	+0.82	0.35
Acetonitrile	312140	296505	299649	+1.06	0.37
Propionitrile	471450	445392	444308	—0.24	0.53
Hydrogen sulphide	136710	126287	130881	+3.63	......
Methyl mercaptan	298810	277967	275540	—0.88	0.09
Ethyl mercaptan	455650	424381	420198	—0.99	0.01
Methyl sulphide	457350	426081	420198	—1.39	0.59
Ethyl sulphide	772170	720055	709515	—1.48	0.08
Methyl sulphocyanide	398950	383315	382311	—0.26	0.05
Methyl mustard oil	392060	376425	382311	+1.56	0.55
Allyl mustard oil	675360	649302	650963	+0.25	0.04
Thiophene	610640	589794	592411	+0.45	0.47
Dimethyl ether	349360	318091	316871	—0.38	0.72
Methyl ethyl ether	505870	464178	461529	—0.55	0.17
Diethyl ether	659600	607485	606188	—0.21	0.63
Methyl allyl ether	627200	585508	585522	+0.01	0.39
Diallyl ether	911100	858985	854174	—0.56	0.47
Methyl propargyl ether	603830	572561	564857	—1.37	0.21
Methylal	476080	434388	440864	+1.49	0.61
Methyl orthoformate	599180	547065	564857	+3.25	0.07
Ethylene oxide	312550	291704	296205	+1.54	0.11
Anisol	936300	894608	888616	—0.67	0.18
Methyl alcohol	182230	161384	165324	+2.44	0.69
Ethyl alcohol	340530	309261	309982	+0.23	0.45
Propyl alcohol	498630	456938	454641	—0.50	0.24
Isopropyl alcohol	493320	451628	454641	+0.67	0.48
Isobutyl alcohol	658490	606375	599299	—1.18	0.23
Trimethyl carbinol	641340	589225	599299	+1.71	0.18
Isoamyl alcohol	820070	757532	743958	—1.82	0.13
Dimethyl ethyl carbinol	810450	747912	743958	—0.55	0.09
Allyl alcohol	464760	433491	433975	+0.11	0.99
Propargyl alcohol	431100	410254	413310	+0.74	1.01
Ethylene glycol	298110	266841	282428	+5.84	0.11
Phenol	768760	737491	737069	—0.06	0.29
Acetic aldehyde	281900	261054	261763	+0.27	0.34
Propionic aldehyde	440720	409451	406421	—0.74	0.23
Isobutyric aldehyde	599900	558208	551080	—1.29	0.59
Dimethyl ketone	437250	405981	406421	+0.11	0.51
Methyl propyl ketone	754190	702575	695738	—0.91	0.12
Formic acid	69390	58967	61996	+5.14	0.81
Acetic acid	225350	204504	206655	+1.05	0.19
Propionic acid	386510	355241	351313	—1.12	0.78
Acetic anhydride	460070	428801	420198	—2.04	0.45
Methyl formate	241210	220364	220432	+0.03	1.08

Compound.	Heat of Combustion, Thomsen.		Calculated.	Percentage Difference.	Thomsen's Variation.
	H_2O Liquid.	H_2O Gas.			
Methyl acetate	399240	367971	365092	—0.79	0.52
Ethyl formate.	400060	368791	365092	—1.01	1.04
Methyl propionate	553950	512258	509749	—0.49	0.46
Ethyl acetate	546570	504878	509749	+0.96	0.76
Propyl formate	558800	517108	509749	—1.44	0.48
Methyl isobutyrate	716940	664825	654407	—1.59	......
Isobutyl formate	719900	667785	654407	—2.04	0.78
Allyl formate	527900	496631	489083	—1.54	0.47
Dimethyl carbonate	357570	326301	316871	—2.98	0.75
Diethyl carbonate	674100	621985	606188	—2.60	0.22
Ethyl nitrate	324040	297982	299649	+0.56	0.31
Ethyl nitrite	334210	308152	320315	+3.94	0.14
Isobutyl nitrite	647660	600756	609632	+1.47	0.67
Amyl nitrite	812640	755313	754290	—0.13	0.43
Nitromethane	180900	165265	175656	+6.28	0.85
Nitroethane	337940	311882	320315	+2.70	0.50

In the foregoing computation the heats of combustion of the compounds named have been assumed to be multiples of the fundamental constant by quantities derived from a definite general formula. The average variation between observation and theory, in 112 cases, is 1.09 per cent., and the variations are distributed as follows:

Variation over 2 percent..16 compounds.
Between 1 and 2 percent..39 compounds.
Under 1 percent..57 compounds.

If we reject, as defective, the observations giving variations above 2 percent. the average variation in the remaining 96 instances is 0.84 percent. Is this amount excessive, or is it satisfactory? To answer this question we must examine the sources of uncertainty in the measurements. They may be summarized thus:

First.—Impurity in the material studied. This error cannot be absolutely avoided, but in Thomsen's work it is doubtless very small. In some cases impurities were recognized, and corrections were applied for them.

Second.—Incomplete combustion. Error probably insignificant.

Third.—Thomsen's data, as cited, all relate to gases at constant pressure. They should be reduced to constant volume. The correction would lower the results of measurement by small amounts, and would produce its greatest effect in the higher homologues of each series.

Fourth. — Uncertainties in the corrections which have been actually applied, and in the factors used in the computations. For example, the uncertainties in the molecular weights of the compounds, though very small, might amount in some cases to two or three hundreds of calories. So also the reduction from liquid to gaseous water is possibly too small, and hence the computed value of the constant may be somewhat too high.

Fifth.—In data and calculations of this kind there is always a distinct possibility that essential physical corrections may have been overlooked and neglected.

Sixth.—In gasifying liquids of high boiling point, Thomsen made use of his "universal burner." This leads to a suspicion, which has often been voiced, that extraneous heat may have been added to that due to the actual combustion.

Seventh.—The average variation between lowest and highest in Thomsen's detailed series of measurements is 0.45 percent.

Taking all of these considerations into account, it seems clear that the actual determinations of heat of combustion may well be uncertain by as much as one per cent. In the last analysis, however, averages cannot be trusted; but each measurement must be scrutinized separately, with reference to its own individual conditions and difficulties. It is probable, also, that the mean value assigned to the henotherm is too high rather than too low, and that its final value may be nearer to the usually accepted value for the neutralization constant, namely, 13 700 calories. With the latter quantity we have already given estimates of the heats of formation of several of the molecules which fell outside of the regular organic series. With the new value, 13 777 calories, the absolute heats of formation of these molecules, as deduced from the general formula, are as follows:

O = O,	13777
Cl — Cl,	13777
Br — Br,	27554
I — I,	55108
N ≡ N,	123993
H — O — H,	82662
O = C = O,	165324
O = S = O,	123993

The apparent heat of formation of gaseous water from molecular hydrogen and oxygen has already been cited as equal to 57 934 calories. From this figure, with the aid of data from the foregoing column, the heat of formation of the hydrogen molecule, H — H, may be deduced. The equation is

$$2[H_2O] - 2[H_2] - [O_2] = 57934 \times 2 = 115\,868;$$

and by substituting the absolute values for O_2 and H_2O we find

$$H_2 \text{ or } H - H = 17\,840.$$

This quantity is of a different order from the henotherm, and bears no simple relation to it. The henotherm, then, is probably not a universal thermochemical unit, and other constants may govern other classes of compounds than those which we have so far studied.

Three of the numbers given in the column deserve special attention; namely, those which represent the heats of formation of chlorine, bromine and iodine molecules. Chlorine, having the smallest value, is easiest dissociated by chemical means, and is therefore the most active of the three elements. Iodine, at the other end of the series, is the most stable, and is hence the most likely to separate from its compounds with reversion to the free state. The value for bromine has already been vindicated by the bromination data of Louguinine and Kablukoff; but that for iodine may at first sight seem to be questionable. The iodine molecule is the one most easily dissociable by heat; at least it dissociates at the lowest temperature; and this fact calls for explanation. In the first place it must be remembered that we are dealing with quantities which represent gramme molecules and not equal weights of the several substances, and that 254 grammes of iodine, 160 of bromine and 71 of chlorine are compared with one another. Secondly, iodine, having the lowest specific heat, is the most easily raised to the dissociation temperature, and between the latter factor and the quantity of heat necessary to separate the iodine atoms there is no known relations. Quantity and intensity must not be confounded.

There is, however, a justification of the three values of a highly suggestive character. According to Thomsen's measurements[1] the apparent heats of formation of gaseous hydro-

[1] Therm. Unt., vol. 2, p. 398.

chloric, hydrobromic and hydriodic acids from their gaseous elements are as follows:

HCl, + 21984 calories.
HBr, + 12244 calories.
HI, — 605 calories.

and between these numbers there is no evident connection. The equations, however, are of this type:

$$2[HCl] - [H_2] - [Cl_2] = 43\,968.$$

whence, with the already determined values for H_2 and Cl_2 the absolute heat of formation of HCl can be evaluated. Applying the process to all three compounds we have, for their absolute heats of formation from free atoms

$HCl = 37842.$
$HBr = 34941.$[1]
$HI = 35869.$

These qualities are of the same order, and are, moreover, approximately double the value assigned to hydrogen. The apparent heat of formation of hydrobromic and hydriodic acids were measured by very indirect processes, and therefore a close agreement could hardly be expected, but probably the three quantities are actually identical. A similar identity is shown by Thomsen's measurements [2] of the heat of reaction between the gaseous halogen acids and gaseous ammonia, the results being as follows:

$NH_3.HCl$	41899
$NH_3.HBr$	45021
$NH_3.HI$	43462

The first of these values is not far from three henotherms, 41 331 calories; although the agreement may be only a coincidence. The equivalency of chlorine, bromine and iodine in their unions with other elements is, however, clear, and the figures given to their respective molecules seem to be well supported.

The approximate equality in heat of formation between the three halogen acids becomes very significant when it is consid-

[1] If Berthelot's determination of the apparent heat of formation of HBr be taken, 13 500 calories, the absolute value becomes 36 197.

[2] Therm. Unt., vol. 2, p. 75.

ered in the light of Faraday's law. Equal quantities of energy, in the form of electricity, are required to effect the decomposition of the three molecules. We now see that equal quantities of thermal energy are needed to produce the same result, or will be liberated in the formation of the compounds. The same principle is operative in both cases, as should be expected, but its influence has hitherto been masked. The apparent heats of formation offer no suggestion of it, but the absolute values speak more clearly. It is to be hoped that in the near future the laws of thermal union and Faraday's law may be more completely correlated.

The application and verification of this principle are evidently complicated by the difficulty of eliminating all purely physical disturbances, such as are due, for instance, to changes of state. Many of the existing thermochemical data are in this respect almost hopelessly complex. And yet, here and there, we find observations of the most suggestive character, as for example, in the determinations which have been made of the heat developed by the solution of an alkaline metal in water. These measurements are as follows, for one gramme atom each of the several metals :

Lithium,	49084	calories,	Thomsen.[1]
"	53200	"	Guntz.[2]
Sodium,	43450	"	Thomsen.
"	42590	"	Joannis.[3]
Potassium,	48100	"	Thomsen.
"	45390	"	Joannis.
Rubidium,	48200	"	Beketoff.[4]
Cæsium,	50000	"	"
"	to 52000	"	"
Calcium,	93440	"	Moissan.[5]
"	to 94740	"	"

It is evident at a glance that these quantities are all of the same order, and that the differences may possibly be ascribed to differences in the liquefaction and ionization of the several metals, and variations in the concentration of the solutions produced.

[1] Therm. Unt., vol. 3, pp. 225, 229, 234.
[2] Compt. Rend., vol. 123, p. 694.
[3] Ann. Chim. Phys. (6), vol. 12, 358.
[4] Jahresbericht, 1891, pp. 481, 483. Data for cæsium approximate.
[5] Compt. Rend., vol. 128, p. 384.

It will be observed that the value for bivalent calcium, which liberates twice as much hydrogen and combines with twice as much hydroxyl as the alkaline metals proper, gives double the usual quantity of heat. Similar figures, comparable with these, are given by De Forcrand,[1] who studied the thermal phenomena attending the solution of the same metals in different alcohols. I cite his data below:

Solvent.	Lithium.	Sodium.	Potassium.
Methyl alcohol...........	55100	48030	50930
Ethyl alcohol	51500	44700	49250
Propyl alcohol..	....	42350	47680
Isobutyl alcohol.........	....	....	41880
Amyl alcohol	....	....	45240

Here again the fundamental identity is manifested, although it is probable that in the different solvents the products of solution were differently, that is, more or less completely ionized. This consideration alone is enough to account for most of the divergencies. All of these reactions are analogous, and the figures given are nearly enough alike to illustrate the principle which I have enunciated. So far, however, we cannot analyze the measurements, and disentangle the separate factors of which they are the algebraic sums.

Another illustration of the difficulties which arise in the interpretation of thermochemical measurements, is offered by Thomsen's[2] data for the apparent heats of formation, in aqueous solution, of numerous metallic halides. His figures for the salts of the alkaline and earthy metals are as follows:

	Chloride.	Bromide.	Iodide.
Lithium.....................	102250	91310	76100
Sodium..	96510	85580	70300
Potassium..................	101170	90230	75020
Magnesium................	186930	....	....
Calcium.....................	187230	165360	134940
Strontium..................	195690	173810	143460
Barium	196810	174940	144520

These quantities, which were determined by indirect methods, are supposed to start from solid metal, solid iodine, liquid bro-

[1] Compt. Rend., vol. 101, p. 318.

[2] Data scattered throughout vol. 3 of Thermochemische Untersuchungen.

mine and gaseous chlorine; that is, from the elements in their usual molecular conditions. To compare them properly, variability of circumstances must be, so far as possible, eliminated; but at present this can only be done in part. We can apply the estimates which have been reached in this memoir, for the heat lost in dissociating the halogen elements. We can also allow for the latent heat of vaporization of bromine, 7 300 calories per gramme molecule, and for the latent heat of fusion and vaporization of iodine $(11.71 + 23.95) \times 254 = 9058$ calories, and all of these quantities are to be added to the respective measurements. In this way we get an approximation to uniformity of condition, regarding chlorine, bromine and iodine all as gaseous. For each halogen molecule, then, we add:

For chlorides	$13777 = 13777$
For bromides	$27554 + 7300 = 34854$
For iodides	$55108 + 9058 = 64164$

It is also best to reduce each measurement to the equivalent of one halogen atom; and then the comparison assumes the form given in the following table:

	Chloride.	Bromide.	Iodide.
Lithium	109138	108737	108182
Sodium	103398	103007	102382
Potassium	108058	107657	107102
Magnesium	101858	....	....
Calcium	100503	100107	99532
Strontium	104733	104332	103812
Barium	105293	104895	104342

The values now approach one another very closely, and suggest an ultimate identity. Each figure represents the heat developed by the union of one, free *gaseous* halogen gramme atom with a *solid* metal, to form a salt in aqueous solution. The ideal gaseous condition cannot be realized throughout, but solutions give something like an approximation to it. For the other metallic halides, also in aqueous solution, the data are less simple, but they still exhibit regularities. Here are Thomsen's determinations.

	Chloride.	Bromide.	Iodide.
Aluminum (Al_2Cl_6) ...	475650	410040	318780
Manganese	128000	106120	75700
Zinc	112840	90960	60540
Iron (Ferrous)...........	99950	78070	47650
Cadmium..................	96250	75640	47870
Cobalt	94820	72940	42520
Nickel......................	93700	71820	41400
Iron (Ferric) (Fe_2Cl_6)	255440	....	....
Tin (Stannous)	81140	....	....
Tin (Stannic)............	157170	....	....
Thallium (Thallous)...	38480	....	....
Lead	75970	54410	....
Copper (Cupric)........	62710	40830	10410
Mercury (Mercuric)...	59860	....	....
Gold (Auric)............	28270	5090	....

Correcting these for the dissociation of the halogen molecules, and for the latent heat of bromine and iodine, and adjusting all to the equivalent of one halogen atom each, we have:

	Chloride.	Bromide.	Iodide.
Aluminum	86163	85434	85212
Manganese	70888	70487	69932
Zinc.	63308	62907	62352
Iron (Ferrous)...........	56863	56467	55902
Cadmium	55013	55247	56017
Cobalt.......................	54298	53897	53342
Nickel	53738	53387	53812
Iron (Ferric).............	49462	....	....
Tin (Stannous).........	47458	....	....
Tin (Stannic)............	46181	....	....
Thallium (Thallous)...	45368	....	....
Lead	44873	44632	....
Copper (Cupric)........	38243	37842	37287
Mercury (Mercuric)....	36818	....	....
Gold (Auric).............	15978	19124	....

Here again the chlorides, bromides and iodides agree quite nearly in thermal value, and the differences between them are doubtless due to physical causes. Other differences are ascribable to differences in the heats of liquefaction and ionization of the metals, quantities which we should expect to vary widely. It is even possible that some of the metallic molecules may be polyatomic, a condition for which no numerical allowance can now be made. Furthermore, the solutions themselves may be differently constituted, some salts being completely, and others partially ionized. Hydrolysis, and perhaps polymerization also, may have modified the ions in some cases, and this consideration is most important. All thermochemical measurements made upon or in solutions should be reëxamined in the light of the modern theory of solutions, in order that the reactions represented may not be misunderstood. The interpretation, by Arrhenius, of the meaning of the neutralization constant, will serve to illustrate the importance of these considerations. I cannot avoid the suspicion that many of the deductions heretofore drawn from a study of the thermal phenomena of solutions have been altogether fallacious. In brief, it would be wise to concentrate our immediate attention upon the thermal behavior of reactions, rather than upon the heats of formation which may be deduced from them. Reactions should be so classified as to exhibit their common factors in accordance with modern ideas; when that work has been done a great advance will become possible.

It would be easy to adduce much more evidence in favor of the principles which I have sought to establish, but I do not wish to overload the argument with details. The definite character of one constant seems to be clear, but the limits of its applicability are yet to be established. A new line of attack upon thermochemical problems has been developed, and it leads to conclusions which are generally novel, and which are sometimes antagonistic to the views of other investigators. For example, the thermal equality of single, double and triple carbon unions is directly opposed to the conclusions reached by Thomsen, whose opinions are always entitled to the highest respect. But this equality is implied in the factor $8n$ of the general formula from which the constant is derived, and without it the constancy would vanish. Thomsen holds that the three modes of union have different thermal values, two of them positive and near together, the third being represented by a small negative quantity. I find that the three values are identical; and the difference between us plainly arises from the different methods of discussion which he and I have employed. This question of method, however, is fundamental, and upon it all further discussion depends. The validity of my formula is the first point at issue, and that must be decided by future research and criticism. I fully recognize the fact that the difficulties of the problem are so far but partly overcome. A path has been opened, but it is not yet perfectly smooth.

CONCLUSIONS.

The evidence presented in this memoir tends to establish a number of conclusions, which may be summarized as follows:

I. The absolute heat of formation of any chemical compound is a function of the number of atomic unions in the molecule.

II. In the group of substances represented by the aliphatic hydrocarbons, their halides, sulphides, ethers and amines, the absolute heat of formation is directly proportional to the number of unions in the molecule.

III. The absolute heat of formation of any organic compound is a multiple, by a whole number, of a single constant. This constant, the henotherm, is identical with the neutralization constant, and has a value somewhere between 13 700 and 13 800 calories.

IV. The thermal value of a union between two atoms is independent of their masses. This is illustrated by the thermal equality of corresponding chlorides, bromides and iodides, and with this observation Faraday's law seems to be correlated.

WASHINGTON, November 17, 1902.

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PAPERS FROM THE HOPKINS STANFORD GALAPAGOS EXPEDITION, 1898–1899.

XIV.

REPTILES.

BY EDMUND HELLER.

CONTENTS.

INTRODUCTION.

Itinerary. — In the fall of 1898 the department of zoölogy of Stanford University, under the patronage of Mr. Timothy Hopkins, of Menlo Park, California, sent to the Galapagos Islands a party composed of two collectors, Mr. Robt. E. Snodgrass and the author, on the sealing schooner *Julia E. Whalen* which was bound on a cruise among those islands. The party was primarily interested in collecting vertebrates, but collections more or less complete were also made in nearly every class of animals and plants. The party had special privileges for collecting and was given an opportunity to collect on every island of the group.

Under the command of Captain Wm. P. Noyes the schooner sailed from San Francisco October 30, 1898. The first island touched at was Guadalupe which was reached November 5 and a single day devoted to exploring its southern extremity. Clipperton Island, a coral atoll, situated in latitude 11° N. and remarkable from being the only coral island in the Eastern Pacific, was visited November 22 and two days spent upon it.

On December 10 the Galapagos Archipelago was reached. On this date Culpepper Island was sighted and a landing effected the same day on its northeast side at the base of a talus slope to which all the collecting was limited, most of the island being inaccessible. Only one day was given to its exploration. The next day, December 11, we arrived at Wenman Island and remained in its immediate vicinity till December 20, making occasional landings whenever the weather permitted. The greater part of our collecting was confined to a low, flat topped island situated north of the main island. Albemarle Island was reached December 28, 1898, and the time from the 28th to the 31st was spent in exploring the region about Iguana Cove. From Iguana Cove we sailed northward to Narboro stopping one day en route at Webb Cove, near Point Christopher, Albemarle Island. The north coast of Narboro was explored on January 5 and 6, 1899, and the central volcano climbed to the summit of the crater's northern rim. The next stop was at Tagus Cove, Albemarle Island, where we anchored January 8 and remained a month at our anchorage. Explorations were made of the region about the cove, the western slopes of the adjacent volcano from sea level to summit of crater, and the eastern coast of Narboro. Leaving our anchorage at Tagus Cove on February 9 for Elizabeth Bay we arrived and anchored there on the 12th and remained till the 26th. Both coasts of the bay and the lower slopes of the two central volcanoes were explored. March 4 found us again at Iguana Cove where two days were spent in further exploration of the same region. On March 10 we again dropped anchor at Tagus Cove after circumnavigating Narboro and revisited much of the territory previously explored. Leaving this anchorage March 27 we anchored again, next day, at Mangrove Point, Narboro Island.

Here we explored the immediate coast and ascended the southeast slope of the volcano to a height of 3,000 feet. On April 8 we left our anchorage and sailed for James Island which we reached April 20 and anchored in James Bay. Here three days were spent in exploring about the bay and inland for a considerable distance. The Seymour Islands were reached on April 27 and an anchorage made near the southern island. Both the Seymour Islands and the northern coast of Indefatigable were explored. Leaving our anchorage May 4 we went to Duncan Island where we arrived the following day. Here three days were spent, on the northern part of the island, and we then proceeded southward to Charles, anchored off Black Beach on the 9th and explored the adjacent coast and interior of the island to the site of the old settlement. On May 11 we set sail for Hood where we arrived on the 14th and anchored in Gardner Bay; we remained here till the 20th. The coast southeast of the bay, and the central part of the island and Gardner Island were explored. From Hood we proceeded northward to Chatham anchoring in Wreck Bay on the 20th. The bay and interior part of the island near the hacienda of Señor Cobos were explored. On May 28 we sailed for Barrington Island where we arrived the same day and remained two days exploring and collecting about the northeast coast where several landings were made. A portion of the interior was also explored. After leaving Barrington we headed for Iguana Cove, Albemarle, where we remained from June 1 to June 10, making landings whenever the weather permitted. Our next anchorage was at Turtle Point just north of Tagus Cove, where we remained from June 13 to 16. After doubling Point Albemarle we proceeded to James Island where one day, the 19th, was spent on its northwest coast. Leaving James we headed for Bindloe Island whither we arrived on June 20 and spent two days exploring its southwest coast and interior. Tower was the next island visited, two days being given to its exploration. Leaving Tower June 23 we proceeded westward to Abingdon. The following day we landed on the west coast of that island and spent two days collecting along the coast and on the west slope of the central peak from sea level to summit.

On June 26, 1899, we took final leave of the Galapagos and headed for Cocos Island, where we arrived three days later and anchored in Chatham Bay. Here we stayed four days. On account of the dense vegetation only the coast and water courses could be explored. From Cocos we set sail, July 2, for San Francisco and after a short stop of one day, August 3, at Clarion Island, Revillagigedo Archipelago, we reached San Francisco on August 30, 1899, having been gone 304 days.

Material. — The material on which the present paper is based consists of nearly 1,200 specimens, being perhaps the largest collection of reptiles yet secured from the Galapagos Archipelago. With this collection as a basis, the attempt is here made to describe all species collected, with descriptions of their variations and habits, and to give the ranges and the synonymy of all the forms known to inhabit the Galapagos Archipelago and Cocos and Clipperton Islands.

Geologic Formation. — The Galapagos Archipelago is chiefly composed of basaltic lava and tufa, the latter, wherever it occurs, underlying the lava and forming the older portions of the islands. The fluidity and low melting point of the basaltic lava has given to the islands their characteristic topography, that is, comparatively low volcanoes with gently sloping sides and immense craters several miles in diameter. This formation is best exhibited on Narboro, Albemarle, Indefatigable and Bindloe, which are the only islands with large central craters. The craters on Charles, Chatham, James, Duncan, Jervis, Barrington and Abingdon are much smaller, being mere potholes in comparison with those of Albemarle. Definite craters are lacking on Hood, Tower, Wenman and Culpepper.

Subsidence Theory. — All the islands are obviously of vol canic origin, yet Dr. Baur[1] invokes a continental origin or connection to explain their faunal characteristics. To account for the presence of representative species on each island he assumes that all the islands in the group were formerly connected, forming one island, and that the species were generally distributed over this connected area before submergence; isolation and changed conditions after submergence are deemed by Dr.

[1] Baur, Biol. Lect. Woods Hole, pp. 67–78, 1894.

Baur to be the causes of the present differentiation. Such a joining together into one island of all the islands of the archipelago, including the northern islands of Wenman and Culpepper, would necessitate an elevation of more than 7,000 feet. Furthermore, a connection with the American continent is thought necessary by the same authority to explain the origin of the fauna and flora of the archipelago. Such connection with the continent would require an elevation of more than 10,000 feet, the present altitude of the islands having been attained through a corresponding submergence, a possible though improbable submergence, from the steep character of the adjacent South American coast which has been rising through a long period of geologic time.

Doubtless the assumed submergence is amply sufficient to account for the faunal characteristics of the archipelago but it is unnecessary and at variance with geological and biological evidence as illustrated in the derivation of the life of other similar groups of islands. Nearly all groups of volcanic islands exhibit similar though perhaps less striking differentiation of the species inhabiting separate islands. Since nearly all have been populated by strays from the present continental masses or from other islands we do not see the necessity of making the Galapagos an exception. Almost all authors from Darwin to Rothschild and Hartert, have regarded the Galapagos as a group of oceanic islands, Dr. Baur alone adopting the subsidence theory.

As a group the Galapagos Archipelago is probably today of greater extent than at any earlier geologic period though much erosion and perhaps some subsidence has taken place. The larger volcanoes are extinct, volcanic activity at present being confined to small lateral vents which in recent years have added only slightly to the size of the islands on which they occur. The northern portion of Abingdon, much of Narboro and Bindloe, some of the western portions of Albemarle and the southwestern part of James appear to be due to rather recent lava flows. Evidences of elevation appear at various localities. Near Iguana Cove, Albemarle there are several old sea cliffs now situated a considerable distance inland. At Tagus Cove on the same island a series of terraces, still containing the characteristic cavities made by sea urchins, are now several hundred feet above the present sea level. Much erosion has taken place, especially about Wenman and Culpepper which formerly were considerably larger than they are now. Wenman appears to have once been the central crater of a larger island. Its steep semicircular northern face is not the result of erosion but at one time it formed the southern wall of the crater whose northern rim has been eroded away. It is only a short time, geologically speaking, since the northern and southern portions of Albemarle were united by the low Perry Isthmus which has the appearance of being built up from a recent lava flow from the southern crater. Had the central crater of Narboro continued active for some time longer it would have poured out lava enough to fill the narrow strait separating it from Albemarle, thus uniting those two islands.

Age of the Archipelago. — In the absence of any available geologic evidence as to the age of the archipelago the degree of differentiation attained by the fauna may be taken as indicative of considerable age. This kind of evidence is most noticeable among the reptiles. The greatest differentiation is shown by the genera *Amblyrhynchus*, *Conolophus* and *Testudo* while some of the others, perhaps later arrivals, as *Orophis*, *Tropidurus* and some of the *Phyllodactyli* show little or no differentiation from continental species. From the prominent West Indian element in the fauna and flora, which may have reached the islands during that part of the Tertiary when the Americas were separated, it would appear that the archipelago is at least of Tertiary age and the presence of *Testudo* would also support this view.

Previous Expeditions. — Previous to Darwin's visit to the Galapagos in 1835 a few reptiles, mostly *Testudo*, had been collected by navigators and presented to various museums. Darwin's collection formed the basis for the first systematic account[1] of the herpetology of the archipelago and consisted of specimens from Chatham, Charles and James.

Later, in 1852, Dr. Kinberg of the Swedish frigate *Eugenie* visited the archipelago and collected reptiles on Albemarle,

[1] Bell, Zool. Beagle, Reptiles, 1843.

Charles, Chatham, Indefatigable and James. These were partially reported on by Peters.[1]

In 1868 Dr. Habel made a collection of reptiles on Abingdon, Bindloe, Hood and Indefatigable. These were reported on by Steindachner[2] who also received most of the reptiles taken by the Hassler expedition in 1872 on Albemarle, Charles, Indefatigable, James and Jervis.

Commander Cookson of the *Petrel*, in 1875, collected some reptiles, chiefly tortoises, at Abingdon, Albemarle and Charles; these have been reported on by Günther.[3]

The *Albatross*, in 1888, made quite extensive collections on Albemarle, Charles, Chatham, Duncan and Indefatigable. These were reported on by Cope.[4]

Dr. Baur, in 1891, made a very extensive collection of reptiles in the archipelago. His specimens are from Albemarle, Abingdon, Bindloe, Barrington, Charles, Chatham, Duncan, Hood, Indefatigable, James, Jervis and Tower. This collection has been reported on by Baur[5] and Garman.[6]

Reptilian Derivation. — Eight genera of repiles occur in the Galapagos Archipelago, two of which are peculiar and obviously of American derivation, being represented by allied genera on the adjacent continental coast. All the genera not peculiar to the archipelago, except *Testudo*, are found on the western slope of the Andes. The distribution of the eight genera of Galapagos reptiles is as follows:

Chelone.	Tropicopolitan.
Gonatodes.	Tropicopolitan.
Phyllodactylus.	Tropicopolitan.
Tropidurus.	Neotropical.
Amblyrhynchus.	Peculiar.
Conolophus.	Peculiar.
Dromicus.	West Indian and Neotropical.
Testudo.	Nearly cosmopolitan; lacking in South America west of the Andes.

[1] Peters, Mon. Berl. Ac., 1869, 71.
[2] Steindachner, Festschr. Zool.-Bot. Ges., Wien, 1876.
[3] Günther, Proc. Zool. Soc., 1877, and Gig. Land Tort., Lond., 1877.
[4] Cope, Proc. U. S. Nat. Mus., XII, pp. 141–147, 1889.
[5] Baur, Festchr. Leuckart, 1892.
[6] Garman, Bull. Essex Inst., XXIV, 1892.

DISTRIBUTION OF REPTILES IN THE GALAPAGOS ARCHIPELAGO.

Name.	Narboro.	Albemarle.	Indefatigable.	South Seymour.	James.	Jervis.	Charles.	Hood.	Barrington.	Duncan.	Chatham.	Bindloe.	Abingdon.	Tower.	Wenman.	Culpepper.
Chelone mydas	x	x	s	s	x	...	...	s	s	s	...	s	s	s	s	s
Testudo nigrita	...	...	...	...	?	...	...	...	...	...	...	...	...	...	...	...
" galapagoensis	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...	...
" guntheri	...	...	...	...	x?	...	...	...	...	...	...	...	...	...	...	...
" wallacei	...	...	...	...	...	...	...	...	...	...	x?	...	...	...	...	...
" vicina	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" microphyes	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" becki	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" ephippium	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...
" abingdoni	...	...	...	...	...	...	...	...	...	...	...	...	x	...	...	...
Gonatodes collaris	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...
Phyllodactylus tuberculosis	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...
" gilberti	...	...	...	...	...	...	...	...	...	...	...	...	...	...	x	...
" galapagoensis	...	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" bauri	...	...	...	...	...	...	x	x	...	...	...	...	...	...	...	...
" leei	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...
Tropidurus grayi	...	x	x	x	x	x	x	...	...	...	...	...	...	...	...	...
" " magnus	x	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" " barringtonensis	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...
" duncanensis	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...
" delanonis	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...
" bivittatus	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...	...
" habeli	...	...	...	...	...	...	...	...	...	...	...	x	...	...	...	...
" pacificus	...	...	...	...	...	...	...	...	...	...	...	...	x	...	...	...
Conolophus subcristatus	x	x	x	x	x	...	...	...	...	...	...	...	...	...	...	...
" pallidus	...	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...
Amblyrhynchus cristatus	x	x	x	x	x	...	x	x	s	x	x	x	x	x	x	x
Dromicus biserialis	x	x	x	...	x	s	x	...	...	...	...	...	...	...	...	...
" " habeli	...	...	...	...	...	...	...	x	...	...	...	...	...	...	...	...

x Collected or recorded by previous collectors.
s Seen.

Excluding *Chelone mydas*, which is a widely spread marine species, the Galapagos reptile fauna consists of twenty-six species and subspecies; of these twenty-five are peculiar and are represented on the adjacent coast of South America by closely allied species.

All species of *Testudo* in the Galapagos are peculiar, and are most closely related to those found in the Mascarenes, of the Indian Ocean, from which they are separated by only slight structural characters. Any land connection between these remote island groups in recent geologic times through a connection of the continents to which they are nearest, forming a connection between South America and Africa, is not to be seriously considered. The similarity of the Mascarenes and Galapagos *Testudo* may be largely due to insular isolation, the two groups having sprung from a similar cosmopolitan type derived from the nearest continent, the absence of enemies and abundance of food on the islands being favorable to the development of gigantic races. These races have developed along nearly the same lines. Western South America at present lacks the genus, and paleontology is as yet silent as to its occurrence or the time of its disappearance there. Assuming that the Galapagos reptile fauna has been chiefly derived from material carried by ocean currents, the present direction of these currents would favor its derivation from South America south of the equator. So little of the fauna and flora is allied to West Indian and Central American forms, however, that it is improbable that during those geological epochs (Tertiary or older) when the Americas were separated by the submergence of part of the connecting isthmus an ocean current from the northeast washed the shores of the archipelago and brought with it such forms. The large Central American element in the Galapagos may be traced to the influence of the seasonal shifting of the present currents about the Panama region which not infrequently bring floating material to the islands from that coast.

The single peculiar species of *Gonatodes* is most closely allied to *G. ocellatus* of the West Indies (Tobago). This genus occurs along the coasts of Ecuador and Peru.

Of the five species of *Phyllodactylus*, four are peculiar and more or less closely related to *P. tuberculosus*, the non-peculiar species which is distributed along the west coast of Mexico, and Central and South America southward to Ecuador.

Tropidurus is distinctly a Neotropical genus with several Peruvian and Ecuadorian species. All the Galapagos species are peculiar and closely related forms, their nearest continental allies being perhaps some of the Peruvian species.

The genus *Conolophus* according to Garman[1] is nearest the Neotropical genus *Enyalioides* which is a common Ecuadorian inhabitant. This affinity is especially well marked in the young

[1] Garman, Bull. Essex Inst., xxiv, 1892, p. 3.

which are said to be nearly indistinguishable. Boulenger[1] places it near Iguana.

The marine Iguana *Amblyrhynchus* is closely allied to *Conolophus*, of which it is perhaps a marine form evolved, as suggested by Garman, on barren islands where vegetation was lacking, thus compelling an alga diet or extermination.

The single species and subspecies of *Dromicus* are both closely allied to *D. chamissonus* of Peru and Chile from which species the Galapagos snakes are doubtfully distinct.

The author is under obligations to Dr. C. H. Gilbert, of Stanford University, in whose laboratory the work has been done, and to Mr. J. O. Snyder, curator of the Leland Stanford Junior University Museum, for many favors received in the handling of the collections.

SYSTEMATIC ACCOUNT.

Genus **Chelone** Brongniart.

Chelone Brongn., Bull. Soc. Philom., II, p. 89, 1800.

Range. — Cosmopolitan in tropical and subtropical seas.

CHELONE MYDAS (Linnæus).

Testudo mydas Linn., Sys. Nat., ed. 10, I, p. 197, 1758.

Range. — Tropicopolitan.

Common among the islands of the Galapagos Archipelago. Most abundant in the shallow lagoons and on the sand beeches where the females come to deposit their eggs.

The crew secured many turtles for food and we observed many others on the beaches. The coloration of the upper parts varied from dark greenish to brownish-red, the reddish coloration greatly predominating in Galapagos specimens. Only one adult specimen was preserved.

The turtles have been driven from some of the islands, on which dogs and pigs have been introduced, by the ravages of these animals on their eggs and breeding grounds and also by Indians who hunt them for their oil. They are, however, still abundant about Albemarle and Narboro.

Genus **Testudo** Linnæus.

Testudo Linn., Syst. Nat., ed. 10, I, p. 197, 1758.

Range. — Ethiopian, Oriental, Mediterranean, Neotropical (east of the Andes) and South Temperate Nearctic.

[1] Boulenger, Cat., II, 1885, p. 186.

Galapagos Testudo (genus *Elephantopus* of Gray). — Nuchal plate absent; a pair of gular plates; frontal region of the skull flat; fourth cervical vertebra biconvex. In *T. galapagoensis* the third cervical vertebra is biconvex. Nine described species peculiar to the Galapagos Archipelago.

Allied most closely by the characters of the skulls and vertebræ to the tortoises of the Mascarenes (Mauritius and Rodriguez Islands) from which they are separated by the divided gular plate.

The following account of the habits of the Galapagos tortoises is based on observations made on the three species collected, viz., *T. microphyes*, *T. vicina* and *T. ephippium*.

Their food consists of various species of grasses and cactus (*Opuntia*). During the rainy season and in the moist portions of the islands the year round grass forms their chief food, especially a large, woody stemmed, perennial species. During the dry season in the arid portions of the islands, as at Tagus Cove, Albemarle, and on Duncan Island, the *Opuntia* becomes quite an important food plant. The green succulent leaf-like stems of this cactus and its fruit, the "prickly pear," are eagerly devoured by the tortoises regardless of the sharp spines with which they are armed. One specimen collected near Tagus Cove had the whole palate and pharynx bristling with cactus spines from which there was apparently no suffering. The juicy cactus stems supply the tortoises with the necessary water in the dry regions where springs are absent and thus make possible its existence in such localities. Cactus seems to be preferred, when it can be easily secured; all the tortoises we took on board the schooner would take no other kind of food except when compelled by hunger. The *Opuntia* are tree-like in habit, growing usually to a large size and it is only the young and smaller plants that are within reach of the tortoises. Grass can be secured much easier and it is perhaps due to this fact that it forms a larger proportion of their food.

The tortoises do a great deal of apparently unnecessary travelling and though slow are so persistent in their journeys that they cover several miles a day. Most of the travelling is done early in the morning and late in the afternoon, the hot hours of noon being spent in the shade of some bush wallowing in the damp soil. The wallowing probably cools them and incidentally relieves them of a few of the numerous wood ticks (*Amblyoma pilosum*) which infest them at the joints and wherever the skin is thin enough to allow them to pierce it. After heavy rains they delight to wallow in the mud. They are very determined travellers and when once started in a certain direction no obstacles can stop them. Not unfrequently they ascend very steep, rocky hills. Sometimes their shells are broken and occasionally they are killed by rolling down these inclines, but if uninjured after these falls they will make repeated effors to reascend until crowned by success. They retire early for the night, drawing in their limbs and neck and after sunset do not move from the place chosen for the night. Darwin, however, states that they travel both day and night when on their periodical visits to the springs.

All three of the species we observed make seasonal vertical migrations. Soon after the rainy season they descend the mountains to the grass covered flats at their bases to feed and deposit their eggs in the light soil. After the grass has withered they again ascend the mountains to the moist meadows produced by the trade winds at an elevation of 2,000 feet and above. These migrations are most marked in the dry regions, as at Tagus Cove, Albemarle, but even at Iguana Cove on the same island where there is an abundance of moisture at lower elevations a nearly complete migration takes place. On Duncan Island the tortoises scatter out so in the dry season that their movements can scarcely be called a vertical migration. In their seasonal pilgrimages they follow well established trails used perhaps for generations. These trails radiate from the higher plateaus as a center and usually follow the floors of the canyons to the flats below. Some of the trails are of considerable length, requiring several days of persistent effort on the part of the tortoise to cover them.

When surprised they draw in their limbs and necks with a deep hiss and suspend operations until they think the danger past. No amount of noise seems to frighten them and the Ecuadorians assert that they are deaf. A small one however taken at Iguana Cove, Albemarle, learned to recognize the voice of its keeper in a few months and would come to the gate of its pen when called though the keeper was hidden from its sight.

The males are sometimes quarrelsome, especially in the breeding season. In fighting the jaws are opened widely and the animals, raised by outstretched necks and limbs to their greatest height, attack one another. Superior height seems to be quite an advantage in a combat allowing the taller to bite down upon the head of his adversary. In these fights they seldom succeed in doing much damage. When turned over on their backs they right themselves by swinging their limbs all in the same direction, which causes the animal to rotate and clear the ground, so that by thrusting out their long necks to the ground and pushing with them the body falls over on the plastron.

During this operation they usually indulge in much grumbling and groaning as if it were a terrible tax on their anatomy. During the breeding season the males are said to "bellow like bulls." The "bellowing" which we heard consisted of a rather low prolonged note which could not have been heard more than a few yards away.

The type localities of most of the Galapagoan species of *Testudo* are shrouded in more or less uncertainty. Most of the early specimens were collected by whalers and other navigators who have left no records of the exact localities from which their specimens came, and it is only by guesses based on the islands touched at by these navigators that the type localities have been approximately fixed. Within recent years authentic specimens have been collected on Albemarle, near Tagus and Iguana Coves, Abingdon and Duncan Islands which comprise four species, the tortoises having become extinct on all the other islands of the archipelago. The identification of these specimens with those previously described has proved troublesome because of the immaturity of some of the types and the rather variable characters upon which some of the species are based. Some of the species may be simply varieties or subspecies but lack of series of specimens forces us to retain all as species.

From the accounts of early navigators who visited the archipelago we learn that gigantic land tortoises formerly inhabited, beside the islands enumerated above, Charles, Chatham, James, Indefatigable and Hood Islands. The form on Indefatigable has only recently become extinct. Some Ecuadorians we met asserted that some years ago they had seen an immense one near the plantation situated in the central crater. Albemarle Island is inhabited by two species whose ranges are separated by a low barren isthmus. Duncan and Indefatigable are supposed by Dr. Günther to be inhabited by the same species; all the other islands are considered to have been inhabited by distinct species. Charles, Chatham and James have each a species referred to them, leaving Hood and perhaps Indefatigable, the only ones not represented by described species. Of the larger islands and those possessing conditions of vegetation suitable for the existence of *Testudo* Narboro, Bindloe, Barrington, and Jervis appear never to have been inhabited. This may in part be accounted for, on the three latter islands, by their inferior height which would greatly lessen the supply of moisture. Narboro, though high, is very rugged and its vegetation confined mostly to the rim of the crater, the coast being fringed by rough, barren lava fields which may account for the absence of tortoises.

The young do not take on their specific characters until nearly adult; they remain very similar in shape, in all the species, for a considerable time. All the young observed possessed striated shells but adults seem to retain or lose this character indifferently in most of the species.

Growth takes place by additions to the outer border of each plate along the soft white seams and probably continues as long as life exists; the largest specimens possess the whitish seams which mark the growing edges of the plates. In youth the annual increase is probably much greater than later. A specimen from Iguana Cove, weighing 29 pounds when taken, doubled its original weight in twelve months accompanied by an increase to the margin of each plate of the carapace of about half an inch or an inch to the diameter of the plate. Its total gain during the year was in length of carapace four inches, in breadth three inches, and in height, one and one-fourth inches. During the colder winter months the consumption of food was greatly lessened and growth correspondingly retarded. The increase in weight during the summer months amounted to nearly three pounds monthly. This tortoise now weighs 130 pounds, having gained 100 pounds in three years. This rapid increase may be abnormal but it shows how rapid their growth may be under favorable conditions of food and warmth, which we believe are even more favorable in the Galapagos where no cool winter season retards their growth.

The extermination of the gigantic land tortoises in the Galapagos seems to have been due chiefly to inroads made upon them by the whalers, orchilla pickers and the "oilers." The tortoises were abundant in the early part of the nineteenth century and the whaling fleets frequenting these waters captured great numbers of them for food. It was the practice of these vessels to take several hundred away alive to be used as desired. In this way many hundreds were taken from the islands. What the whalers began the orchilla pickers and "oilers" completed. The orchilla pickers who visited the archipelago annually for several years to gather orchilla (*Roccella*) used the tortoises for food wherever they could be obtained. In their search for orchilla they visited the higher altitudes where the orchilla is most abundant and incidentally captured such tortoises as were safe from the whalers by nature of their habitat. These people brought with them their domestic animals, dogs, cats, pigs, etc., which upon their departure were left on the islands to complete or rather continue the extermination. Of these animals dogs and pigs have been most destructive in digging up the eggs and eating the young. The "oilers" have been perhaps the most destructive agents. It was the business of these people to kill the tortoises for the oil which they contained. For this purpose they have been hunted systematically on many of the islands and practically exterminated.

Their natural enemies according to Darwin were *Conolophus*, which dug up the eggs and devoured them, and *Buteo*, the Galapagos hawk, which is said to eat the young when just issuing from the eggs.

TESTUDO NIGRITA Dumeril and Bibron.

Testudo indica GRAY, Syn. Rept., p. 9, 1831, and Cat. Tort., p. 5, 1844, and Sh. Rept., I, p. 6, 1855, and Suppl., p. 5, 1870 (part).—SOWERBY and LEAR, Tort., pl. VI, 1872.
Testudo nigrita Dum. and Bibr., II, p. 80, 1835.—GÜNTHER, Phil. Trans., CLXV, p. 267, 1875, and Gig. Land-Tort., p. 69, pls. XXX, XXXI, XLII, XLIV, 1875.—BOUL., Cat. Chel. Brit. Mus, p. 169, 1889.—BAUR, Am. Nat., XXIII, p. 1043, 1889.—ROTH, Novit. Zoöl., IX, No. 3, p. 618, 1902.
Testudo planiceps GRAY, Cat. Sh. Rept., I, p. 6, pl. XXXIV, 1855, and Suppl., p. 5, 1870.
Testudo elephantina STRAUCH, Chel. Stud., p. 83, 1862.
Testudo elephantopus GRAY, Proc. Zoöl. Soc., p. 708, 1870, and App. Cat. Sh. Rept., p. 3, 1872.
Elephantopus planiceps GRAY, Proc. Zoöl. Soc., p. 724, 1873.

Range.—Type locality unknown.

Two specimens referred to this species by Günther were taken in the Galapagos Islands by the Hassler expedition, but it is not known from which island they came.

TESTUDO GALAPAGOENSIS Baur.

Testudo elephantopus JACKSON, Bost. Soc. Nat. Hist., Journ., I, pp. 443–521, 1837.
Testudo galapagoensis BAUR, Am. Nat., XXIII, p. 1044, 1889.—GÜNTH., Novit. Zoöl., IX, No. 2, pp. 184–192, pls. XVI–XXI, 1902.

Range.—Charles Island.

Two specimens taken by the U. S. S. *Potomac*, one representing the type, are undoubtedly referable to Charles Island. This species has probably been extinct since 1840, the penal colony established on Charles Island by the Ecuadorian Government in 1829 having accomplished their extermination.

TESTUDO ELEPHANTOPUS Harlan.

Testudo elephantopus HARLAN, Jour. Ac. Phil., V, p. 284, 1827.—GÜNTH., Phil. Trans., CLXV, p. 261, 1875, and Gig. Land Tort., p. 63, pls. XXX. XLII–XLIV, LI–LIII, 1877.—ROTH., Novit. Zoöl., IX, No. 2, p. 448, 1902,
Testudo nigra BOUL., Cat. Chel. Brit. Mus., p. 170, 1889.
Testudo güntheri BAUR, Am. Nat., XXIII, p. 1044, 1889.

Range. — Unknown.

James Island has been suggested by Baur as the probable habitat of this species on the strength of the dome-shaped carapace. The measurements of the carapace, however, are duplicated by specimens from Iguana Cove, but we have seen no skulls from this locality with a deep recess before the occipital condyle and sharp edges to the pterygoids as in Günther's figure of this species.

TESTUDO WALLACEI Rothschild.

Testudo wallacei ROTH., Novit. Zoöl., IX, No. 3, p. 619, 1902.

Range.—(?) Chatham Island.

This species was described from a specimen of uncertain origin obtained by Wallace from the Bullock collection where it was catalogued as "Indian Tortoise." Chatham Island has been suggested as the habitat of the species by its describer on the clue given by Captain Porter's remark that the James Island tortoises were round. Most closely allied to *T. galapagoensis*.

TESTUDO VICINA Günther.

Testudo elephantopus BAUR, Am. Nat., XXIII, p. 1044, 1889.
Testudo vicina GÜNTH., Phil. Trans., CLXV, p. 277, 1875, and Gig. Land Tort., p. 73, pls. XLVII and LIV, 1877.—BOUL., Cat. Chel. Brit. Mus., p. 170, 1889.—LUCAS, Smith. Rept., p. 643, pl. CIV, 1889.
Testudo nigrita COPE, Proc. U. S. Nat. Mus., XXII, p. 147, 1889.

Range.—Albemarle Island from Iguana Cove eastward along the southern slopes of the two southern volcanoes to Cape Woodford and Perry Isthmus, absent from the barren southern slopes of the volcanoes. Vertical range from sea level to 4,000 feet altitude. (*Petrel*, *Albatross*, 1888, Rothschild Expedition, Hopkins Standford Expedition.)

This species was found rather common near Iguana Cove in June, 1899, but during our previous visit in December, 1898, only two were found, the tortoises being at that season of the year in the high plateaus. This species inhabits a moist region supporting a heavy growth of underbrush and small trees. Food is abundant throughout the year and the conditions are ideal for the great development of tortoises in size and numbers. The largest living tortoises are perhaps to be found here. We observed a few large males that we estimated would weigh about four or five hundred pounds.

The shells in this species are more symmetrical, the carapace being rounded in horizontal outline and more or less dome-shaped without much anterior flaring. The limbs are considerably shorter than in *T. microphyes*.

MEASUREMENTS OF *Testudo vicina*.

Sex.	Male.	Male.	Male.	Male.	Male.	Male.	Female.	Female.	Female.	Female.
	Centim.	Centim.	Centim.	Centim.	Centim.	Centim.	Centim.	Centim.	Centim.	Centim.
Carapace, length	109	96	91	103	115	103	75	73	93	81
	%	%	%	%	%	%	%	%	%	%
" width	71	76	78	77	73	76	79	82	87	81
" " posteriorly at 8th marginal plate	70	73	77	75	71	75	79	78	81	79
" height at nuchal notch	33	41	41	36	39	37	41	41	43	35
" " median	49	52	60	50	47	49	52	58	58	51
Gular plate to nuchal notch	26	29	36	29	34	22	32	31	34	29
Anal plate to last marginal	16	21	32	22	21	17	19	18	19	19
Plastron, length	72	76	76	71	70	73	65	82	81	81
" " bridge	39	46	47	42	41	43	46	50	49	46
" width	71	70	70	70	68	71	73	78	83	77
" depth of concavity	23	23	20	19	23	20	15	10	08	15
Fore limb, length from elbow	30	..	31	31	29	33	31	33	32	32
Hind limb, length from knee	28	...	33	32	24	31	31	31	36	34

The above table is derived from measurements made from *adult* living specimens taken by the crew. The specimens are not in the zoölogical museum of Stanford University.

The first row of the table shows the length of carapace, in centimeters, measured between the neck and tail notches. All other figures in this and the following tables of *Testudo* measurements, are percentages of length of carapace, *except* concavity of plastron. Concavity of plastron is expressed in percentages of length of plastron bridge.

The most distinctive feature of the skull in our specimens is found in the tympanic cavity, which is bordered posteriorly by a prominent process just above the notch made by the Eustachian tube, causing the notch to appear very deep. The pterygoid edges are moderately flattened. The occipital condyle is large and preceded by a wide open cavity.

The carapace is usually striated in the young, but in the adults this character is nearly or quite lost, only a few striations appearing, in some specimens, on the margins of the plates. A few large males were seen that had conspicuously striated plates, from which it is inferred that striation has no specific value but is merely due to individual variation.

TESTUDO MICROPHYES Günther.

Testudo microphyes GÜNTH. Phil. Trans., CLXV, p. 275, 1875, and Gig. Land Tort., p. 78, pls. XXXII–XXXVIII and XLII–XLV, 1877. — BOUL., Cat. Chel. Brit. Mus., p. 170, 1889. — BAUR, Am. Nat., XXIII, p. 1044, 1889.
(?) *Testudo nigrita* LUCAS, Smith. Rept., p. 643, pl. CIV, 1889 (figure resembles *T. vicina* rather than this species).

Range. — Albemarle Island; Tagus Cove and the slopes of the adjacent volcano (Petrel, Hopkins Stanford Expedition).

None are now to be found in the immediate vacinity of Tagus Cove where apparently they have been extinct for a considerable time. A few may still be found a short distance inland on the sides of the adjacent volcano. During several weeks' exploration on the western side of this volcano not more than seven or eight tortoises were met with and these were all adult males. They range vertically from near sea level to the rim of the volcano, 4,000 feet. The absence of young might be accounted for by the destruction of the eggs by wild dogs but why no females were found is unaccountable. The report by whalers that tortoises occur on the northern volcano of Albemarle makes it probable that this species ranges to Point Albemarle as the two volcanoes are not separated by any wide stretch of impassable lava. The Ecuadorians report a species of tortoise on Cowley volcano which if this form, as seems very probable, indicates a distribution as far south as Perry Isthmus.

In comparison with the Iguana Cove form, *T. vicina*, this species is more elongate with longer limbs and higher carapace which, in the male, has a flaring anterior border as in the Duncan Island form. This difference in shape may be due to difference in climatic conditions. Tagus Cove being dry and desert-like, with well marked wet and dry seasons, could support only an active long limbed species that could do much foraging during the long dry season.

In one specimen seen the coloration varied from the customary blackish in having the rostral, mandible, and angles of the jaw yellowish as in *T. ephippium*.

Our material consists of the shells and skulls of four large males taken east of Tagus Cove.

The skulls differ from those of *T. vicina* as follows:

1. Tympanic cavity not armed posteriorly by a prominent process, the Eustachian notch shallow.

2. Occipital condyle small with a more or less definite recess anteriorly (in one specimen the recess is as deep as in *T. nigrita*).

3. Pterygoid edges less flattened (in one specimen they are sharp).

The skulls differ from those of *T. ephippium* of Duncan Island in the characters of the pterygoid edges and the recess before the condyle much as *T. vicina* does but the Eustachian notch is similar. Comparison of these skulls seems to show that some of the characters upon which herpetologists have placed specific value are subject to considerable individual variation. Skull No. 4800 Stanford Museum in the characters of the occipital recess and the pterygoid edges is a perfect facsimile of the skull figured by Günther as *T. elephantopus*.

MEASUREMENTS OF *Testudo microphyes*. ADULT MALES.

Cat. No. Stan. Univ. Mus.	4799	4805	4800	4806
	Centim.	Centim.	Centim.	Centim.
Carapace, length	96	99.5	94	90
	%	%	%	%
" " over curve	114	114	111	119
" width	69	67	71	77
" " posteriorly at 8th marginal plate	70	67	71	77
" height at nuchal notch	35	37	40	...
" " median	46	43	47	...
Gular plate to nuchal notch	32	32	32	...
Anal plate to last marginal	19	17	17	...
Plastron, length	70	70	71	75
" " bridge	40	38	40	42
" width	66	62	66	66
" concavity	15	15	15	15

TESTUDO EPHIPPIUM Günther.

Testudo ephippium GÜNTH., Phil. Trans., CLXV, p. 271, 1875; Gig. Land Tort., p. 81, pls. XXXIX, XLII–XLIV, 1877; Novit. Zoöl., III, p. 329, pls. XX–XXII, 1896.—BOUL., Cat. Chel. Brit. Mus., p. 171, 1889.

Testudo abingdonii BAUR, Am. Nat., XXIII, p. 1039, 1889 (part).

Range. — Duncan Island. (*Albatross*, 1888 and 1891; Rothschild Exped.; Hopkins Stanford Expedition).

Rather common on the higher parts of Duncan Island especially about the fertile basins of the old craters. The exact locality of the type is unknown. Günther has referred it, at different times, to both Charles and Indefatigable Islands for various reasons, none of which are very convincing. The Indefatigable form as described by Ecuadorians is a much larger and more symmetrically shaped species. The *Tropiduri* of the two islands are so different that we would be surprised to find the *Testudo* showing no differences.

Duncan Island is comparatively low and, being centrally situated, is robbed of a good deal of moisture by the weather islands. Though without living water and subject to drought for several consecutive seasons yet it has supported many tortoises. When we visited the island in May, 1899, in the height of the rainy season, we found the crater dry and the deep soil fissured in all directions by the heat, indicating little rainfall that season. The tortoises evidently find enough moisture in the *Opuntia*, or other vegetation, to supply their wants during these dry seasons.

The species has a longer carapace and limbs than *T. microphyes* which may be attributed to climatic conditions, still dryer than those which prevail at Tagus Cove. It is readily distinguishable from either of the Albemarle species by its peculiar flaring and elongate carapace and its slightly reddish coloration. Its size is considerably less, the largest males found weighing only about fifty pounds.

MEASUREMENTS OF *Testudo ephippium*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	4802	....	....	4803	....	....
Sex.	Male.	Male.	Male.	Female.	Female.	Female.
	mm.	mm.	mm.	mm.	mm.	mm.
Carapace, length	750	640	720	600	512	530
	%	%	%	%	%	%
" " over curve	114	...	...	117	...	...
" width	65	80	73	70	75	81
" " posteriorly at 8th marginal	66	84	77	72	75	81
" height at nuchal notch	42	53	54	46	52	51
" " median	49	55	57	52	54	53
Gular plate to nuchal notch	37	42	44	30	39	38
Anal plate to last marginal	13	20	21	15	19	13
Plastron, length	80	93	85	82	91	92
" " bridge	39	47	44	42	46	50
" width	63	77	68	66	72	77
" concavity	12	16	16	04	11	10
Fore limb from elbow, length	...	38	40	...	35	39
Hind limb from knee, length	...	41	40	...	39	38

Our material consists of the shells and skulls of a pair of adults and observations and measurements on five live specimens taken by the crew.

The skulls have the broad pterygoid edges and wide shallow recesses before the occipital condyles as in Günther's figure of the type, from the characters of which there is no important divergence. The notch formed by the Eustachian tube on the posterior border of the tympanic cavity is shallow.

The soil of Duncan Island is a dark red loam and the reptiles all partake more or less of a similar coloration. They have a slight tinge of dark brick red above and the skin of the limbs, neck, and head is similarly colored, with the exception in the latter of the anterior portion of the rostral, the mandible, and the angles of the jaws, which are pale yellowish. The upper portion of the throat in some specimens is also yellowish.

TESTUDO BEDSI Rothschild.

Testudo bedsi ROTH., Novit. Zoöl., VIII, No. 3, p. 372, 1901.

Range. — Cape Berkeley, northwestern point of Albemarle. Described as intermediate between *T. ephippium* and *T. abingdoni.*

TESTUDO ABINGDONI Günther.

Testudo abingdonii GÜNTHER, Gig. Land Tortoises, p. 85, pls. XL, XLI, XLV, XLVIII, L, 1877 ; Novit. Zoöl., III, p. 330, 1896. — BOULENGER, Cat. Chel. Brit. Mus., p. 171, 1889.

Testudo ephippium BAUR, Am. Nat., XXIII, p. 1039, 1889 (part).

Range. — Abingdon Island (*Petrel*, 1875, *Albatross*, 1888).

Probably now nearly extinct. None seen by us in June 1899, on the northwest slope of Abingdon. The northern and northwestern slopes of the island were explored by us from sea level to summit of highest peak without finding even a trace of the present or past existence of *Testudo.* What tortoises now remain on the island are probably confined to the moister and greener southern slopes where the *Albatross* and *Petrel* secured their specimens.

In shape of carapace and in cranial characters this species closely approaches *T. ephippium.* The skull of the type of *T. abingdoni* possesses a much deeper recess before the occipital condyle but this difference might disappear in a series of skulls.

Genus **Gonatodes** Fitzinger.

Gonatodes FITZINGER, Syst. Rept., p. 91, 1843.

Range. — Malayan, Indian, Australian and Tropical American. Galapagos Archipelago (one peculiar species).

GONATODES COLLARIS Garman.

Gonatodes collaris GARM., Bull. Essex Inst., XXIV, p. 11, 1892.

Range. — Galapagos Archipelago; Chatham Island (Baur).

We did not meet with this species during our stay at Wreck Bay, Chatham Island where Baur secured his specimens.

Genus **Phyllodactylus** Gray.

Phyllodactylus GRAY, Spicil. Zoöl., p. 3, 1870.

Range. — Mediterranean, African, Australian and Tropical American. Galapagos Archipelago (four peculiar species and one of wide distribution).

PHYLLODACTYLUS TUBERCULOSUS Wiegmann.

Phyllodactylus tuberculosus WIEGM., Nova Acta Ac. Leop.-Carol., XVII, p. 241, pl. XVIII, fig. 2, 1835. — COPE, Proc. U. S. Nat. Mus., XII, p. 145, 1889. — GARMAN, Bull. Essex Inst., XXIV, p. 9, 1892.

Range. — Western South America from Ecuador northward through Central America and Mexico to Cape San Lucas, Lower California. Galapagos Archipelago; Chatham Island (*Albatross* 1888, Baur).

The *Albatross* secured two specimens on Chatham Island which Cope referred to this species. These we have examined and find they agree essentially with Boulenger's description of *P. tuberculosus.*

We did not meet with this species in the archipelago.

MEASUREMENTS OF *Phyllodactylus tuberculosus.*

CHATHAM ISLAND.

Cat. No. U. S. Nat. Mus.	14949.	14956.
	mm.	mm.
Head and body, length	45	48
Tail, length	34+	60
	%	%
Snout to ear	27[1]	28[1]
Snout	13	13
Diameter of eye	7	8
Width of head	20	21
Fore limb	34	33
Hind limb	46	42
Submentals	2	2
First infralabial compared to mental	½	⅓

[1] The percentages in this table are based on length of head and body as the unit of comparison.

PHYLLODACTYLUS GILBERTI sp. nov.

Type.—Cat. No. 4549, adult male, Leland Stanford Junior University Museum; Wenman Island, Galapagos Archipelago, December, 1898.

Range.—Galapagos Archipelago: Wenman Island (Hopkins Stanford Expedition). Occurs abundantly under the loose lava blocks and scoria.

Specific Characters.—Dorsal tubercles small, keeled, in two to six continuous longitudinal series on dorsum; rump crossed by eight rows becoming ten anteriorly, the outer series on each side disappearing before reaching middle of back. Occiput covered by equal granules. Tail inferiorly with a median series of enlarged scales. Digital pallets wide, more than one half diameter of eye, trapezoid. Mental triangular, not much larger than the first infralabial.

Description of the Type.—Dorsal tubercles small, two or three times the size of the dorsal granules, rounded, juxtaposed and feebly keeled, in ten longitudinal series on sacral region; back and nape crossed by four rows, the three outer rows on each side disappearing before reaching middle of back. Rows of tubercles separated by two or three rows of granules; tubercles in the rows juxtaposed with few exceptions. Digital pallets wide, four times width of rest of digit, nearly two thirds diameter of eye, trapezoid. Fourth toe with fourteen transverse lamellæ inferiorly, the distal one divided. Head large, one half as long and two thirds as wide as the body. Ear opening elliptical, oblique, two thirds diameter of eye. Snout rounded at tip, the dorsal profile oblique; length slightly less than twice the diameter of eye. Interorbital more or less concave; occipital region flat. Limbs moderate, the appressed fore limb reaching anterior border of eye; hind limb reaching appressed elbow. Head covered above with equal granules, smallest on occiput, becoming gradually larger anteriorly. Nostril situated between rostral, first superior labial, internasal and two posterior nasals. Internasals contiguous. Rostral twice as broad as high, slightly pentagonal with a median cleft above, bordered dorsally by two internasals. Mental subtriangular, longer than wide with obtuse angle posteriorly, followed by two hexagonal submentals. Superior labials six before middle of pupil, twice as long as high; five inferior labials anterior to middle of pupil, as high as long, first largest and more than two thirds size of mental. Belly and lower surfaces covered with smooth, rounded, imbricate scales; forty-five transverse series between axilla and groins. Tail of type imperfect. In younger specimens the tail is cylindrical, tapering gradually, covered above and on sides with imbricate, keeled scales about size of dorsal tubercles; covered inferiorly with a median series of enlarged scales.

Coloration in Life.—Above pinkish-gray with dusky blotches and spots; a median light pinkish stripe from nape to tail forking into several faint narrow cross bars on back. Head lighter grayish with irregular dusky blotches above, snout faintly dusky spotted, labials more heavily spotted, a dusky stripe beginning at tip of snout, passing through eye above ear opening and becoming obsolete on shoulder, widest and most distinct just posterior to eye; sides lighter, dusky, spotted. In perfect specimens the tail is light like the head, the dark cross-bands narrower than the light areas and anteriorly broken up into spots. Limbs above barred and blotched with dusky. Underparts cream or whitish, the scales with minute dark dots.

Variations.—Longitudinal series of dorsal tubercles varying from two to six, the tubercles in the outer rows often little larger than the granules and only partly juxtaposed. Rows of ventral scales between axilla and groins forty-four to forty-eight. Superior labials eight or nine, inferior usually seven. One specimen has the internasals separated by a median row of scales, in all the others they are contiguous. Transverse lamellæ under fourth toe twelve to fourteen.

Coloration above varying from thickly dusky blotched with distinct median light stripe to light grayish, faintly dusky shaded without evident light stripe and with dark stripe through eye almost obsolete.

Young with the median dorsal light stripe beginning sharply at base of head and extending to beginning of tail; widening out into six light cross-bars on back, the light areas narrower than the dark ones, the latter splitting on the sides into short forks. Tail light grayish with twelve wide dusky bars. Stripe through eye pronounced, extending to above shoulder. Top of head and snout dusky spotted. Limbs above with oblique dusky bars. Under surfaces whitish, the scales minutely dark spotted.

This species is unique among those possessing keeled tubercles in the possession of less than ten rows of dorsal tubercles on the dorsum. Its derivation from a form possessing ten or more rows is evident as shown by the ten rows on the sacrum. The shape and size of the digital pallets and the median series of enlarged scales on inferior surface of the tail ally it to *P. tuberculosus* from which it differs in the size and number of rows of dorsal tubercles, the smaller size and lighter coloration and in the absence of larger granules on the occiput and limbs.

Named for Dr. C. H. Gilbert, of Stanford University.

MEASUREMENTS OF *Phyllodactylus gilberti.*

Cat. No. Stan. Univ. Mus.	4549	4553	4552	4548	4557	4555	4550	4547	4554
Sex and Age.	Adult Male.	Adult Male.	Adult.	Adult Male.	Adult.	Adult.	Adult Male.	Young.	Young
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	52	50	52	44	44	39	46	41	35
Tail, length	...	...	...	48	40	43	...	...	35
	%	%	%	%	%	%	%	%	%
Snout to ear	27	28	27	29	29	29	27	29	27
Snout	13	12	13	14	15	14	13	15	14
Diameter of eye	6	6	7	7	7	7	7	7	7
Fore limb	33	35	34	37	39	34	35	34	37
Hind limb	43	41	44	43	43	43	41	43	46
Width of head	20	21	20	23	23	22	20	22	23

PHYLLODACTYLUS GALAPAGOENSIS Peters.

Phyllodactylus galapagoensis PETERS, Mon. Berl. Ac., p. 720, 1869. — STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien, p. 329, 1876. — GARMAN, Bull. Essex Inst., XXIV, p. 9, 1892.

Range. — Galapagos Archipelago; Albemarle Island at Tagus and Iguana Coves and on the southeast coast (Kinberg; Baur; Hopkins Stanford Expedition).

Specific Characters. — Digital pallets small, width less than one half diameter of eye, rounded or oblong. Dorsal tubercles in ten to twelve (usually twelve) very regular series, tubercles large, juxtaposed, trihedral, extending forward on nape. Occiput covered with unequal granules. Mental large, two to four times the size of the first infralabial. Submentals two to four, usually three.

Peters' description of the dorsal tubercles and the three submentals of the type fixes this species as the Albemarle form from which island his specimens must have come. Garman does not distinguish clearly between this form and *P. bauri.* The difference between the two species is not one of number of rows of tubercles for these are variable in each but it is rather a difference in the size and number of the tubercles, causing juxtaposition in the one and separation in the other. Submentals usually more than two. Proportions the same as in *P. bauri.* The present species approaches *P. tuberculosus* in the character of the dorsal tubercles but is smaller, differently colored, without enlarged tubercles on the limbs, with smaller and rounded digital pallets and with the enlarged scales on the inferior surface of the tail not arranged in a single row.

The species was found abundant at Iguana Cove under loose blocks of lava near the coast and along dry creek beds. The small spherical

MEASUREMENTS OF *Phyllodactylus galapagoensis.*

Locality.	Iguana Cove.					Tagus Cove.				
Cat. No. Stan. Univ. Mus.	4980	4985	5007	5012	4978	5023	5029	5026	5028	5021
Sex and Age.	Adult Male.	Adult Male.	Immature Male.	Adult Female.	Adult Female.	Adult Male.	Adult Male.	Adult Female.	Adult Female.	Adult Female.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	43	45	38	43	43	43	44	38	43	37
Tail, length	...	50	44	...	40	...	48	...	52	...
	%	%	%	%	%	%	%	%	%	%
Snout to ear	27	28	28	27	27	27	28	27	27	28
Snout	12	12	12	12	12	12	13	12	13	12
Diameter of eye	7	8	8	7	7	7.5	7.5	8	7	7
Width of head	19	20	19	20	19	20	18	19	18	20
Fore limb	33	36	35	35	31	36	38	3 7	38	35
Hind limb	42	44	43	44	40	43	42	47	49	46

eggs were found commonly in the same situations, many containing large embryos at this season (December). At Tagus Cove they were much less common. Found only at the head of the cove under loose blocks of tufa and in mangrove swamps near Turtle Point where a few were secured beneath the bark of *Avicennia*. Such individuals as inhabit mangrove swamps may occasionally be carried out to sea on logs or other drift material and thus floated to other islands. It seems quite probable that this may have been the manner of their distribution. The stomachs of these mangrove swamp specimens contained remains of the large crickets, *Liparoscelis*, which also live beneath the bark of the same trees.

Phyllodactylus galapagoensis.

Cat. No. Stan. Univ. Mus.	Locality, Albemarle Id.	Rows of Dorsal Tubercles.	Tubercles in the Two Median Rows.	Sub-mentals.	Size of First Infralabial Compared to Mental.
4978	Iguana Cove.	12	42–38	3	one third.
4979	" "	12	52–54	3	one third.
4980	" "	12	42–40	2	one third.
4982	" "	10	40–35 +	3	one fourth.
4983	" "	12	45–44	4	one third.
4985	" "	12	45–45	4	one fourth.
4986	" "	12	40–40	2	one third.
4987	" "	12	42–44	3	one third.
5007	" "	12	40–38	3	one third.
5008	" "	12	36–38	3	one half.
5009	" "	12	44–44	3	one third.
5011	" "	12	38–43	3	one third.
5012	" "	12	43–41	3	one third.
5013	" "	12	47–45	3	one fourth.
5014	" "	10	38–40	3	one fourth.
5019	Tagus Cove.	12	45–45	4	one third.
5021	" "	11	38–36	5	one fourth.
5022	" "	12	40–36	3	one fourth.
5023	" "	12	40–42	3	one third.
5028	" "	11	40–41	5	one fourth.
5029	" "	12	35–36	2	one third.

PHYLLODACTYLUS BAURI Garman.

Phyllodactylus galapagoensis GÜNTHER, Proc. Zoöl. Soc., p. 67, 1877.—BOUL., Cat. Liz. Brit. Mus., I, p. 82, 1885.—COPE, Proc. U. S. Nat. Mus., XII, p. 145, 1889.

Phyllodactylus bauri GARMAN, Bull. Essex Inst., XXIV, p. 10, 1892.

Range.—Galapagos Archipelago: Charles Island (Petrel, Albatross, 1888 (?), Baur, Hopkins Stanford Expedition); Hood Island (Hopkins Stanford Exped.); Gardner Island (Hopkins Stanford Expedition).

Specific Characters.—Digital pallets small; width less than one half diameter of eye: rounded or oblong. Dorsal tubercles small, MEASUREMENTS OF *Phyllodactylus bauri.*

Locality.	Charles.						Hood.		Gardner.		
Cat. No. Stan. Univ. Mus.	4990	4995	4994	5001	5003	5005	5030	5031	5033	5032	5034
Sex and Age.	Adult Male.	Adult Male.	Adult Female.	Adult Female.	Adult Female.	Adult Female.	Immature Male.	Adult Female.	Adult Female.	Immature Male.	Immature Male.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length.	42	40	44	39	39	38	36	42	32	37	37
Tail, length	...	...	...	...	40	43	43	...	36	...	45
	%	%	%	%	%	%	%	%	%	%	%
Snout to ear	26	27	26	26	26	27	29	28	28	28	29
Snout	13	13	12	13	12	13	14	13	13	13	14
Diameter of eye	7	7	7	8	7	8	8	8	8	7	7
Width of head	18	19	19	19	18	18	19	20	20	20	21
Fore limb	31	31	33	32	32	33	34	29	34	31	35
Hind limb	40	40	39	39	42	41	42	40	40	39	41

rounded, separated by granules in the rows; in ten to twelve, usually ten longitudinal series. Mental large, two to four times the size of the first infralabial; submentals two.

This species is very close to *P. galapagoensis*, from which it differs chiefly in the fewer and smaller dorsal tubercles, which are not juxtaposed but separated by granules. The submentals are always two. These differences hold good in a series of twenty-one specimens from Charles, Hood and Gardner Islands. The specimens average lighter colored than the Albemarle form. More material may show this form to be only a subspecies of *P. galapagoensis*.

This species occurs commonly at Black Beach, Charles Island. Found beneath rocks near the coast. Much less common on Hood and Gardner.

Phyllodactylus bauri.

Cat. No. Stan. Univ. Mus.	Islands.	Rows of Dorsal Tubercles.	Tubercles in the Two Median Rows.	Size of First Infralabial Compared to Mental.
4989	Charles	11	35-36	one third.
4990	"	10	34-35	one third.
4991	"	12	37-35	one third.
4994	"	10	34-34	one third.
4995	"	10	33-35	one third.
4996	"	10	28-31	one third.
4997	"	10	33-33	one third.
4998	"	10	27-28	one third.
4999	"	10	40-41	one fourth.
5000	"	10	27-27	one third.
5001	"	10	37-35	one third.
5002	"	10	30-31	one third.
5003	"	11	28-27	one third.
5004	"	10	30-32	one fourth.
5005	"	10	34-34	one third.
5006	"	12	30-29	one third.
5030	Hood.	12	30-28	one third.
5031	"	10	35-34	one third.
5032	Gardner	12	31-34	one third.
5033	"	12	29-27	one third.
5034	"	10	28-29	one half.

PHYLLODACTYLUS LEEI Cope.

Phyllodactylus leei COPE, Proc. U. S. Nat. Mus., XII, p. 145, 1889. — GARMAN, Bull. Essex Inst., XXIV, p. 11, 1892.

Range. — Galapagos Archipelago; Chatham Island (Albatross, 1888; Baur; Hopkins Stanford Expedition).

Three specimens secured on Chatham Island. Cat. No. 5037, Stan. Univ. Mus., is quite different in coloration from the others being much lighter with no trace of the dark stripe through the eye and with the dark bands of the back only faintly indicated; the auricular meatus is nearly closed.

MEASUREMENTS OF *Phyllodactylus leei.*

(From Wreck Bay, Chatham Island.)

Cat. No. Stan. Univ. Mus	5037	5035	5036
Sex and Age.	Adult Male.	Immature Female.	Adult Female.
	mm.	mm.	mm.
Head and body, length	37	29	35
Tail, length	...	31	34
	%	%	%
Snout to ear	26	29	28
Snout	11	13	12
Diameter of eye	7	8	7
Width of head	17	20	20
Fore limb	32	32	34
Hind limb	42	43	43
Submentals	3	2	2
Size of first infralabial compared to mental	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{3}$
Internasal plates	0	1	2

Genus **Tropidurus** Wied.

Tropidurus Abbild. WIED, Naturgesch. Bras., pl. 1824?; Beitrage Naturgesch. Bras., 1, p. 137, 1825.

Range. — Neotropical. Galapagos Archipelago (six peculiar species).

Occurs abundantly on most of the islands and islets of the archipelago; lacking only on Culpepper, Wenman and Tower. Apparently nearly extinct on Charles. On all the other islands it is the commonest reptile. Most abundant along the coast and in the dryer parts of the islands, nearly or quite disappearing in the damp and heavily wooded portions and in the higher altitudes at 2,000 feet and above.

The Galapagos hawk, *Buteo*, is the chief native enemy of *Tropidurus.* The owls, *Strix* and *Asio*, may occasionally feed upon them. The range of *Buteo* coincides almost perfectly with that of *Tropidurus*, lacking only on Charles Island where *Tropidurus* is very rare.

May and June are the breeding months. The eggs are four to six in number, white and elliptical. Many of the females were seen at various islands in May and June digging short oblique tunnels in the sand presumably for the reception of the eggs.

KEY TO GALAPAGOS SPECIES AND SUBSPECIES OF *Tropidurus.*

A_1 Ninety scales or less in a transverse series around middle of body.

B_1 Sides of neck granular and much folded between ear opening and anterior oblique fold.

C_1 No red on tail; scales large, 58 to 73 in circumference of body.

D_1 Female without dark transverse bars above.

E_1 Below light; scales in circumference of body 58 to 68; female usually plain olivaceous above; length of head and body in male less than 100 mm. ......*grayi grayi*.

E_2 Plumbeous below; length of head and body in male usually 100 mm. or greater; scales in circumference of body 58 to 60.......................... .... *grayi magnus*.

D_2 Female with dark transverse bars above; scales in circumference of body 66 to 73; length of head and body in male 91 to 100 mm.................*grayi barringtonensis*.

C_2 Coloration of tail extensively reddish; scales smaller, 70 or more in circumference of body.

D_1 Tail and belly red; scales smaller, 80 to 90 in circumference of body; female dark spotted on throat and breast; size smaller, length of head and body, male 90 mm., female 75 mm.............................*duncanensis*.

D_2 Tail red laterally, inferiorly yellowish like belly; scales larger, 70 to 80 in circumference; female immaculate below; size larger, length of head and body, male 115 mm., female 90 mm.....................................*delanonis*.

B_2 Sides of neck scaled; no folds between ear opening and anterior oblique fold of neck.

C_1 Scales large, 55 to 65 in circumference of body; height of dorsal crest in male on nape ⅔ internasal width; plates on top of head more divided and equal in size; male with two longitudinal light stripes on sides; small, length of head and body in male 80 mm., female 60 mm ....*bivittatus*.

C_2 Scales small, 68 to 75 in circumference of body; height of dorsal crest in male on nape 1½ internasal width; plates on top of head fewer and unequal; male light spotted above; larger, length of head and body in male 100 mm., female 70 mm...*habeli*.

A_2 More than 90 scales in transverse series around middle of body. *pacificus*.

TROPIDUURS GRAYI GRAYI (Bell).

Leiocephalus grayii BELL, Zoöl. Beagle, Rept., p. 24, pl. XIII, fig. 1, 1843 (part). — GRAY, Cat., p. 218, 1845 (part). — GÜNTHER, Proc. Zoöl. Soc., p. 67, 1877 (part).

Holotropis grayii A. DUM., Cat. Meth. Rept., p. 70, 1851 (part) and Arch. Mus., VIII, p. 538 (part).

Craniopeltis grayii PETERS, Mon. Berl. Ac., p. 645, 1871.

Tropidurus (*Craniopeltis*) *grayii* STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien, p. 310, pl. II, fig. 1, 1876 (part).

Tropidurus grayi Boul., Cat., II, p. 172, 1885 (part). — Cope, Proc. U. S. Nat. Mus., XII, p. 145, 1889 (part). — Baur, Biol. Centralbl., X, p. 475, 1890. — Boul., Ann. N. H. (6), VII, p. 502, 1891 (part). — Baur, Festschr. Leuckart, p. 265, 1892.

Tropidurus indefatigabilis Baur, Biol. Centralbl., X, p. 476, 1890 and Festschr. Leuckart, p. 268, 1892.

Tropidurus albemarlensis Baur Biol. Centralbl., X, p. 476, 1890, and Festschr. Leuckart, p. 269, 1892.

Tropidurus jacobii Baur, Festschr. Leuckart, p. 268, 1892.

Range. — Galapagos Archipelago; Charles Island (Darwin, Kinberg, Baur); Indefatigable (Kinberg, Hassler, Albatross 1888, Baur, Hopkins Stanford Exped.); James (Hassler, Albatross 1888, Baur, Hopkins Stanford Exped.); Jervis (Hassler, Baur); Albemarle (Hassler, Cookson, Albatross 1888, Baur, Hopkins Stanford Exped.).

Specific Characters. — Sides of neck granular with numerous folds between ear opening and anterior oblique fold. Scales in circumference 58 to 68. Considerable variation in coloration but tail never red; underparts usually light; females plain olivaceous above. Males less than 100 mm. in length of head and body.

Head plates variable but never as divided as in *T. bivittatus.* Frontal usually small; prefrontals large, commonly four. Internasals not usually confluent with prenasals. Supraoculars five to seven, varying much in shape. Sides of neck granular and much folded, there being two oblique folds on side of neck and several irregular folds behind the ear opening.

There is much individual variation in size and coloration, especially in the specimens from Albemarle where the conditions of vegetation and moisture are so various. Individuals inhabiting the barren black lava fields and living only near the coast are usually larger and darker than those found in the brush-covered areas. On islands where there is little diversity of conditions, as on the Seymours, the individual variation is correspondingly less. The specimens from the different islands comprising the range of this species show a little local variation but individual variation is so great that it is almost impossible to define the former.

Charles Island. — Baur's description of his only specimen from the type locality, a female, agrees in coloration and scale counts with some females of *T. g. grayi* from James and Seymour from which form the Charles Island specimens are perhaps not separable. *Tropidurus* is apparently now almost extinct on this island where formerly it was not uncommon. Its extinction is probably due to the introduction of domestic animals, chiefly cats, which have spread over the whole island and feed on the lizards. Three days were spent, in May, 1899, collecting on the western and central portions of the island but without finding any traces of *Tropidurus*.

Indefatigable Island.—An adult male, Cat. No. 4862 Stan. Univ. Mus., from Indefatigable shows the following coloration. Above olive-brown, head lighter brown; back marked anteriorly with transverse blackish bars; whole dorsal surface except the head spotted with grayish. A dark stripe on side of head beginning below eye and extending above ear to nape. Sides of head and neck posterior to eye reddish, black-spotted. A black antehumeral spot. Sides of body reddish, finely black-spotted. Breast and lower jaw rosy red, with large black blotches; throat black. Belly light greenish-gray; tail and hind limbs inferiorly light blue-gray. Fore limbs spotted below like breast.

Thirty-seven adult males are in the collection, nine from the northern coast of Indefatigable, twenty from South Seymour and eight from North Seymour Island. The coloration of the breast varies from red through orange to buff, the black blotches in some specimens obscuring the ground color; in some others the breast is only sparingly spotted. A few are light grayish above, like *T. g. barringtonensis*.

Length of head and body 72 to 80 mm.

An adult female, Cat. No. 4875 Stan. Univ. Mus., from Indefatigable, is olive-brown above, becoming lighter on head and tail. Sides of head and neck from snout to antehumeral fold brick-red. A black ante-humeral spot. Sides of body reddish, unspotted. Mandible and breast posteriorly yellowish; the chin reddish. Throat light slate, darker spotted; forebreast lighter grayish, dark-spotted. Belly, hind limbs and tail inferiorly grayish.

Twenty-seven adult females are in the collection from Indefatigable and the Seymour Islands. These show little variation in coloration. Several are marked on the sides by two dark longitudinal bands, the lower band extending from axilla to thigh, the upper from ear to above thigh.

Length of head and body 58 to 67 mm.

In the Indefatigable specimens the male approaches much nearer the size of the female. The females are scarcly distinguishable in coloration from some specimens from James Island, while the males approach closer in size and coloration to Albemarle specimens.

Generally distributed, most abundant coastwise. The specimens from the Seymour Islands show scarcely any variation from those taken on Indefatigable. They average slightly lighter colored and larger.

Stomachs of Indefatigable specimens contained insects and spiders; those from the Seymours insects, seed cases and berries.

James Island. — Coloration in life of an adult male, Cat. No. 3918, Stan. Univ. Mus. Above dark brown-spotted with blackish and light grayish spots, dorsal crest and the scales at its base light grayish, hind limbs and tail above lighter dusky brown, the former light-spotted; head above olive brown. Belly, thighs and tail inferiorly light grayish, breast buffy and pinkish, sparingly black spotted, throat black, mandible pinkish, black spotted posteriorly. Sides of head light brownish, preoculars light spotted, lower eyelid bluish; sides of neck bright red, black spotted; a black antehumeral spot, light bordered anteriorly; shoulders blotched with yellowish and brown. Sides of body lake red, spotted with black and whitish spots except about axilla and along sides of belly.

The fifteen adult males in the collection show the following variations in coloration: throat and belly darker, plumbeous-gray, dorsum without lighter spots, some light above with transverse black bars as in *T. g. barringtonensis.*

Coloration in life of an adult female, Cat. No. 3913 Stan. Univ. Mus. Above golden-brown, crest grayish-white, nape and tail lighter without golden coloration; limbs above like dorsum. A dark brown band, two scales wide, extending from ear to above thigh, a lighter or fainter one from axilla to thigh. Belly, hind limbs and tail inferiorly light grayish; breast, throat and mandible canary-yellow, black-spotted. Sides of head orange-red; sides of neck and body red, brightest anteriorly, lake red posteriorly, on body the scales light-edged, sparingly dark-spotted; a black antehumeral spot.

Of the seventeen females taken at James Island only two have the lateral stripes as described above. Some are much darker on throat and chest with only a median light streak.

The darker specimens are indistinguishable from the average Albemarle specimens but show less variation than the latter and the females as a whole are indistinguishable from Indefatigable specimens.

The stomachs examined contained spiders, insects and seeds.

Albemarle Island, Iguana Cove.—Coloration in life of an adult male, Cat. No. 4711, Stan. Univ. Mus. Above olive-brown, flecked with pale greenish-gray, dorsal crest like spots except on nape where it is dark-spotted; limbs above like the back. Head uniform brownish, sides of body same but dark-spotted. Sides of neck tinged with reddish; a black antehumeral spot. Belly pale greenish-gray, bordered with brick red on the sides; limbs and tail inferiorly like the belly. Breast chrome-yellow spotted with black, the throat clay-yellow, much spotted with black, mandible grayish, labials greenish.

The males secured at Iguana Cove show much variation. Those inhabiting the light soil in brushy areas are lighter, in some the breast being yellowish with a few scattered spots and throat grayish. Others taken near the beach on black basaltic lavas have the breast, throat and mandible solid blackish and the belly plumbeous. Some of the light specimens are considerably lighter above than the one described, the dorsal crest being entirely light grayish and sides of belly dark-spotted with the dark markings of the back arranged in transverse bars.

Coloration in life of an adult female, Cat. No. 4709, Stan. Univ. Mus. Much darker brown above than the male, with light dorsal crest, black-spotted above; tail somewhat lighter with a greenish dorsal crest and light spots; fore limbs like the back; hind limbs like the tail, light-spotted. Belly pale greenish-gray, breast golden, black-spotted; throat and mandible brick red. Tail and hind limbs inferiorly like the belly; fore limbs like the breast, black-spotted. Sides of throat, mandible and body brick red; a black antehumeral spot.

Some of the females in the collection are as dark as the darkest males. Most of them lack red on the mandible, sides of the head and neck which separates them somewhat from specimens secured on James and Indefatigable.

Four specimens taken at Point Christopher on black lava are dark plumbeous below. Specimens secured at Elizabeth Bay on black lava are also dark and of only average size.

Albemarle Island, *Tagus Cove.* — Coloration in life of an adult female, Cat. No. 4694, Stan. Univ. Mus. Above brown, spotted with lighter brown, except on tail which is grayish-brown. Hind limbs like the tail, fore limbs colored like the back. Belly light grayish, hind limbs and tail inferiorly the same. Breast pale yellow, spotted with black; throat dark with yellow-edged scales; chin lighter, grayish, dusky-spotted; infralabials and mental pinkish. Sides dull brick, black-spotted; a dark stripe from ear to thigh, and another fainter one from axilla to thigh. Sides of head and neck brighter red with a dark antehumeral spot.

The males vary from light below, sparingly spotted on breast to black throat and breast with plumbeous belly. Those inhabiting the coast are larger and darker as a rule. The females vary in the same manner as the males but are smaller in comparison to the males in the dark forms.

Specimens secured near Black Bight are larger and darker, approaching *T. g. magnus* of Narboro in size and coloration.

Tropidurus grayi.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Scales in Circumference.	Length of Head and Body.	Length of Tail.
				mm.	mm.
4888	James.	Male.	62	87	134
4896	"	"	66	95	.....
4885	"	"	68	83	.....
4907	"	"	65	84	.....
4862	Indefatigable.	"	64	80	.....
4859	"	"	60	72	109
4869	"	"	64	72	103
4871	"	"	60	77	.....
4643	Albemarle.	"	60	86	102
4650	"	"	62	81	114
4700	"	"	60	88	135
4716	"	"	62	83	115
4887	James.	Female.	64	68	102
4889	"	"	65	60	92
4906	"	"	65	65	102
4900	"	"	63	65	91
4863	Indefatigable.	"	60	67	103
4860	"	"	66	58	101
4866	"	"	60	58	92
4857	"	"	66	60	.....
4613	Albemarle.	"	58	58	90
4595	"	"	62	65	.....
4716	"	"	58	66	92
4709	"	"	62	73	92

TROPIDURUS GRAYI MAGNUS subsp. nov.

Type. — Adult male, Cat. No. 3974, Stan. Univ. Mus., from Narboro Island.

Range. — Galapagos Archipelago; Narboro Island (Hopkins Stanford Expedition).

Subspecific Characters. — Males large, length of head and body 100 to 105 mm. Under parts dark, the breast and throat black and the belly plumbeous. Females much smaller than the males, length of head and body 63 to 71 mm. Scales large, 56 to 60 in circumference of body.

Description of the Type. — Coloration above dark olive, nape and dorsal crest greenish-gray, the entire dorsum excepting head, tail and hind limbs spotted with black; tail and hind limbs light blue-gray-spotted; tail greenish posteriorly. Sides of head olive; sides of neck and body dark slaty, spotted with black; a black antehumeral spot. Inferior surfaces of hind limbs, tail and mandible plumbeous, the latter spotted with black posteriorly; throat black; breast and fore limbs proximally dark slaty-spotted with black; belly grayish plumbeous.

Length of head and body 105 mm. Scales in circumference of body 60.

An adult female, Cat. No. 3985, Stan. Univ. Mus., which exhibits the typical coloration is uniform dark brownish-olive above, considerably darker than in the male; sides of head and body similar. Below dark plumbeous, darkest on throat where nearly black; breast and mandible spotted with black; the chin grayish-green.

Much variation occurs in the sixty specimens secured from various parts of Narboro. The typical form occurs all along the barren lava fields bordering the coast where they feed on the littoral crustacea. Farther inland where the lava is overgrown with vegetation they become smaller and lighter colored, resembling specimens secured on Albemarle in similar situations.

The food of the smaller inland form consists of insects, and the seed capsules and ovaries of various flowers.

Tropidurus grayi magnus.

Cat. No. Stan. Univ. Mus.	3881	3974	3989	4560	3965	3985	4575
Sex.	Male.	Male.	Male.	Male.	Female.	Female.	Female.
Scales in circumference of body	60	60	60	58	59	58	56
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	104	105	100	105	63	71	62
Tail, length	155	114+	147	.....	105	106	...

TROPIDURUS GRAYI BARRINGTONENSIS (Baur).

Tropidurus barringtonensis BAUR, Festchr. Leuckart, p. 267, 1892.

Range. — Galapagos Archipelago; Barrington Island (Baur, Hopkins Stanford Expedition).

Subspecific Characters. — Scales in circumference of body, 65–73; female dark-barred above; male light grayish above with dark bars, the breast and lower jaw reddish; length of head and body in male 91–100 mm., in female 66–76 mm.

Coloration in life of an adult male, Cat. No. 3934, Stan. Univ. Mus. Above light grayish-brown, tail darker grayish; whole upper surface except head spotted with blue-gray; the dorsum anteriorly and fore limbs black barred and spotted; hind limbs and tail without dark bars. Head above olive green, grayish on sides and neck, black-spotted. A black antehumeral spot. Sides of body behind axilla reddish, black-barred and spotted; belly yellowish, spotted with pinkish and dusky on sides; breast and lower jaw brick red, spotted with black; chin yellowish without darker spots; throat black; fore limbs inferiorly red, black-spotted proximally like the breast; tail and hind limbs below light grayish-green.

Sixteen adult and three immature males are in the collection. In these alcoholic specimens the coloration of the belly varies from grayish or whitish to light buff. Throat in a few specimens medially yellowish, black-spotted. Sides of neck red in two specimens.

Length of head and body 91 to 100 mm.

Coloration in life of an adult female, Cat. No. 3907, Stan. Univ. Mus. Above grayish-brown, the dorsum crossed by dusky transverse bars; whole dorsal surface except head spotted with blue-gray; limbs above dusky barred like back; head above olive brown, sides of snout grayish. Sides of head and neck from eye to antehumeral spot brick red; sides of body behind axilla pinkish, obsoletely spotted with dusky; a black antehumeral spot. Belly and inferior surfaces of hind limbs and tail light grayish; breast lemon-yellow, spotted with black; throat medially like the breast, spotted with dark brown; sides of body reddish; lower jaw pinkish, spotted with dusky; fore limbs inferiorly colored like breast, the forearm unspotted.

The collection contains twenty-four adult females. In the majority of these the belly is light blue-gray. The breast, throat and chin in some specimens are sparingly spotted with darker.

Length of head and body 66 to 76 mm.

Scales small, 65 to 73 in circumference of body.

Some of the darker males are not distinguishable in size and coloration from specimens of *T. g. grayi* from James Island. As a series these specimens are more uniform in size and coloration than those from other islands.

MEASUREMENTS OF *Tropidurus grayi barringtonensis.*

Cat. No. Stan. Univ. Mus.	3903	3906	3910	3920	3908	3911	3922	3933
Sex and Age.	Adult Male.	Adult Male.	Adult Male.	Adult Male.	Adult Female.	Adult Female.	Adult Female.	Adult Female.
Scales in circumference............	67	73	70	67	71	70	69	66
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	95	95	100	91	66	70	76	66
Tail, length........	150	...	145	...	...	107	...	110

Distributed generally over the entire extent of Barrington Island but most abundant about the sand beaches.

Food insectivorous. All the stomachs examined contained insects, chiefly Orthoptera.

Many of the females secured during our visit (May 29–30) contained large eggs.

TROPIDURUS DUNCANENSIS Baur.

Tropidurus grayi COPE, Proc. U. S. Nat. Mus., XII, p. 145, 1889 (part). — BOUL., Ann. N. H. (6), VII, p. 502, 1891 (part).
Tropidurus duncanensis BAUR, Biol. Centralbl., x, p. 477, 1890, and Festschr. Leuckart, p. 270, 1892.

Range. — Galapagos Archipelago; Duncan Island (Albatross 1888, Baur, Hopkins Stanford Expedition).

Specific Characters. — Belly and tail inferiorly red; breast and mandible dark-spotted; throat black. Sides of neck granular, much folded behind ear-opening. Scales small, 80 to 90 in circumference of body. Length of head and body: of male 83 to 95 mm., of female 70 to 76 mm.

Plates on top of head variable as in *T. g. grayi.* A single small frontal plate; prefrontals usually four, large. Parietal large, bordered laterally by two temporals. Dorsal crest in male of medium height; highest on tail; height at nape one half internasal width.

Coloration of adult male, Cat. No. 4912, Stan. Univ. Mus. Above olive-brown, black-spotted except the head; tail more brownish with few dark spots; hind limbs and tail light blue-gray-spotted; fore-limbs dark-spotted like back. Sides of head and body from snout to tip of tail brick red, finely black-spotted on sides and along the belly where the red is brightest; a black antehumeral spot. Throat black; breast, mandible and fore limbs reddish, black-spotted; chin, belly, and hind limbs and tail inferiorly red.

Twelve males are in the collection. In some the breast as well as the throat is black, in others it varies from red to orange, black-spotted. A few are spotted with blue-gray on back.

Length of head and body 83 to 95 mm.

Coloration of adult female, Cat. No. 4919, Stan. Univ. Mus. Above olive-brown. Sides of head and body from snout to tip of tail brick red, darkest dorsally where the red extends high up and encroaches on the dorsum, brightest along belly; a black antehumeral spot. Below red from mandible to tip of tail, darkest anteriorly on lower jaw, brightest on tail; breast and belly lighter, breast darkspotted.

Ten females are in the collection, all of them varying considerably from the above. Sides spotted in some, others with breast dusky. Red of sides not always running high up on dorsum. Tail usually dark at tip like dorsal surface.

Length of head and body 70 to 76 mm.

The coloration of this species is quite distinctive and separates it at once from reddish specimens of *T. g. grayi.*

Occurs abundantly in the central part of Duncan Island. Especially common in the old crater at the north end where their coloration harmonizes with the red soil forming the floor of the crater; much rarer near the coast. Their food consists exclusively of insects. The stomachs examined contained grasshoppers, caterpillars, grubs, beetles, etc.

MEASUREMENTS OF *Tropidurus duncanensis.* ALL ADULT.

Cat. No. Stan. Univ. Mus.	4908	4918	4928	4929	4919	4920	4925	4927
Sex.	Male.	Male.	Male.	Male.	Female.	Female.	Female.	Female.
Scales in circumference	88	90	84	82	87	85	80	80
Head and body, length	mm. 87	mm. 85	mm. 95	mm. 83	mm. 70	mm. 72	mm. 72	mm. 76
Tail, length	131	133	140	135	113	106	110	108

TROPIDURUS DELANONIS Baur.

Tropidurus grayi COPE, Proc. U. S. Nat. Mus., XII, p. 145, 1889 (part). — BOUL., Ann. N. H. (6), VII, p. 502, 1891 (part).

Tropidurus delanonis BAUR, Biol. Centralbl., X, p. 476, 1890, and Festschr Leuckart, p. 269, 1892.

Tropidurus hoodensis BAUR, Festschr. Leuckart, 1892, p. 263.

Range. — Hood Island (Albatross 1888, Baur, Hopkins Stanford Expedition); Gardner Island (Hopkins Stanford Expedition).

Specific Characters. — Sides of tail red, belly and tail inferiorly yellowish, male spotted on breast, female usually immaculate below. Parietal plate small, width one and one fourth internasal width or less, bordered on each side by a single large temporal between which it is sunk. Scales in circumference of body 70 to 80. Large, length of head and body in male 111 to 125 mm., female 85 to 96 mm.

Head plates varying considerably, in some specimens nearly as divided as in *T. bivittatus.* The parietal however is smaller than in other species, its width varying from one to one and one fourth internasal width. Supraoculars usually narrow, six or seven. Height of dorsal crest in male at nape one half internasal distance.

Coloration in life of adult male, Cat. No. 3876, Stan. Univ. Mus., from Hood Island. Above olive-brown, spotted, except the head, with light yellowish; tail dark reddish, the crest light brown; hind limbs reddish, light-spotted distally; fore limbs like sides of body. Belly medially and hind limbs and tail inferiorly dusky-yellow; the belly anteriorly and laterally red. Mandible dark greenish-gray, throat black, chest black with large straw-yellow blotches. Fore limbs below proximally like breast. Sides of head and neck light brown with black blotches; sides of body reddish, spotted with light yellow; tail brick red on sides.

The collection contains eighteen adult males from Hood and Gardner Islands, those from Gardner having the reddish areas brighter. In some the dorsum is only sparingly light-spotted and without light spots on the sides. The immature males are unspotted above like the females.

Length of head and body 111 to 125 mm.

Coloration in life of adult female, Cat. No. 3874, Stan. Univ. Mus., from Hood Island. Body and tail above olive-brown; limbs similar in coloration. Sides of belly and tail reddish; a black antehumeral spot. Whole head, throat and chest brick red, becoming darker on nape and top of head, fading to dull orange on anterior belly; belly and tail and hind limbs inferiorly cream-yellow; fore limbs below proximally like breast.

There are nineteen adult females in the collection from Hood and Gardner Islands. A single specimen has the breast dark-spotted, all the others being immaculate below.

Length of head and body 85 to 96 mm.

This is the largest species of the archipelago. Some specimens from Narboro nearly equal it in size but differ much in coloration and size of scales. Some forms of *T. grayi* approach it somewhat in coloration but the red on the sides of tail and the unspotted lower parts of the female seem to be distinctive.

MEASUREMENTS OF *Tropidurus delanonis*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	3871	3873	3882	3883	3861	3863	3867	3874
Sex.	Male.	Male.	Male.	Male.	Female.	Female.	Female.	Female.
Scales in circumference	72	74	76	72	75	70	80	72
Head and body, length	mm. 121	mm. 125	mm. 125	mm. 111	mm. 96	mm. 85	mm. 90	mm. 95
Tail, length........	.....	.....	.....	.....	...	120	124	145

This species is generally distributed over Hood and Gardner, but as on the other islands of the archipelago they occur much more abundantly near the coast.

Food consists of insects, seed capsules and berries. Stomachs examined contained grasshoppers, beetles, caterpillars, seeds and berries.

TROPIDURUS BIVITTATUS (Peters).

Leiocephalus grayii Bell, Zoöl. Beagle Rept., p. 24, 1843 (part). — Gray, Cat., p. 218, 1844 (part). — Günther, Proc. Zoöl. Soc., p. 67, 1877 (part).
Crainopeltis bivittata Peters, Mon. Berl. Ac., p. 645, 1871.
Tropidurus (*Crainopeltis*) *grayii* Steindachner, Festschr. Zoöl.-Bot. Ges., Wien, p. 310, 1876 (part).
Tropidurus grayii Boul., Cat., ii, p. 172, 1889 (part).
Tropidurus lemniscatus Cope, Proc. U. S. Nat. Mus., xii, p. 145, 1889. — Baur, Biol., Centralbl., x, p. 475, 1890.
Tropidurus bivittatus Boul., Ann. N. H. (6), vii, p. 501, 1891. — Baur, Festschr. Leuckart, p. 272, 1892.

Range. — Galapagos Archipelago; Chatham Island (Darwin, Kinberg, Albatross 1888, Baur, Hopkins Stanford Expedition.).

Specific Characters. — Two oblique folds on side of neck; no folds between ear opening and anterior oblique fold; sides of neck scaled. Male with two longitudinal light stripes above. Scales in circumference of body 55 to 65. Small, length of head and body in male 66 to 85 mm., female 57 to 61 mm.

Plates on top of head small and numerous; about equal in size. The frontal and azygos plates between prefrontals and frontonasals equal in size to prefrontals. Prefrontals transversely divided forming eight; frontonasals four. Crest of male about one half internasal distance in height, highest on tail.

Coloration in life of adult male, Cat. No. 4951, Stan. Univ. Mus.; above olive-brown, top of head darker brown; a light stripe two and one half scales wide beginning behind eye, running slightly upward above ear and along sides to base of tail; a narrow stripe of the same color beginning at axilla and extending along sides to base of thigh. Belly yellowish, red-tinged; breast, tail and hind limbs below soiled whitish or grayish; throat and lower jaw same; sides of head grayish; sides of body below lateral stripe barred yellow and brick red; a black antehumeral spot. Limbs above spotted with brown and gray; tail posteriorly light brown.

The fourteen adult males in the collection are all dusky-spotted on breast, throat, mandible and limbs. The immature males are whitish below without dusky spots. One large male is wholly buff below.

Length of head and body 66 to 85 mm.

Coloration in life of adult female, Cat. No. 4950 Stan. Univ. Mus. Above golden brown, darker on top of head and along base of dorsal crest; limbs above like back. Sides of head brownish; sides of throat and body bright brick red; a slaty antehumeral spot with black center. Belly and inferior surfaces of limbs cream; tail yellowish below. Chin greenish; rest of lower jaw, throat and breast buffy. Eyelids dark blue-green.

The collection contains eleven adult females, all of which exhibit considerable variation. Mandible and throat in some spotted with dusky; tail dorsally black-barred and dorsum bronze-brown in a few specimens.

Length of head and body 57 to 61 mm.

This is the smallest and in some respects the best marked species in the archipelago.

Occurs abundantly near the coast at Wreck Bay. None were seen inland more than a mile from the coast, their absence being due probably to the saturated condition of the soil and great amount of surface water.

Food consists of insects, spiders, blossoms and seed capsules, the former predominating in the stomachs examined.

MEASUREMENTS OF *Tropidurus bivittatus*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	4743	4756	4947	4951	4754	4755	4761	4950
Sex.	Male.	Male.	Male.	Male	Female.	Female.	Female.	Female.
Scales in circumference	60	60	63	62	60	63	65	58
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	66	76	85	75	58	61	57	60
Tail, length	119	131	...	127	95	92	...	90

TROPIDURUS HABELI (Steindachner).

Tropidurus pacificus (var. *habeli*) STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien, p. 314, pl. II, fig. 2, 1876.
Tropidurus pacificus BAUR, Biol. Centralbl., X, p. 479, 1890. — BOUL., Ann. N. H. (6), VII, p. 501, 1891 (part).
Tropidurus habelii BAUR, Festschr. Leuckart, p. 271, 1892.

Range.—Galapagos Archipelago; Bindloe Island (Habel, Baur, Hopkins Stanford Expedition).

Specific Characters.—Sides of neck scaled; no folds between ear-opening and anterior oblique fold of neck. Dorsal crest in male high, height on nape equal to one and one-half internasal distance. Male above brownish without darker spots. Scales in circumference 68 to 75.

Sides of neck with two oblique folds; no folds between ear-opening and anterior oblique fold. Crest in male high; height at nape equal that on tail. Sides of neck covered with scales. Plates on top of head very irregular and unequal; internasals confluent with prenasals (one exception); prefrontals three to six. Dorsal crest in female low, equal one sixth internasal width.

Coloration in life of adult male, Cat. No. 4937, Stan. Univ. Mus. Above dark brown, spotted with light gray; crest grayish; tail and nape olive-brown; limbs above lighter, more spotted; top of head olive-brown. Belly grayish; breast red with dark blotches; throat and lower jaw also dark but with more red than breast. Sides of body and neck lake red; a black antehumeral spot.

Eleven adult males are in the collection. None of the alcoholic specimens show any light spots on dorsum. The coloration of the breast varies from dark red heavily dark-blotched to lighter reddish, obsoletely spotted with darker.

Length of head and body 99 to 108 mm.

Coloration in life of adult female, Cat. No. 4930, Stan. Univ. Mus. Above dusky greenish, spotted with black, becoming dusky on tail and brown on head; limbs above with much light olive. Sides of body dark lake red, chest lighter red; lower jaw and throat dark like sides Belly and limbs below clay yellow; tail inferiorly dusky yellow. Sides of head light brown; sides of neck dark red like throat; a black antehumeral spot.

The five adult females in the collection show little or no variation.

Length of head and body 67 to 72 mm.

In size the males average a little larger than *T. pacificus*, but the females are considerably smaller than in that species. Tail shorter than in *T. pacificus*, less than one and one half head and body, varying from one and one tenth to one and one third head and body. This species is not very close to any other of the archipelago. Its distinctive features are its coloration and the possession in the male of a high dorsal crest. The absence of granules on the sides of the neck ally it to *T. bivittatus* from which in other respects it is very different.

Occurs abundantly throughout the brushy portions of Bindloe Island. Found sparingly along the coast on the barren lava fields.

Its food appears to be wholly vegetable. All the stomachs examined contained blossoms, seed capsules and berries.

MEASUREMENTS OF *Tropidurus habeli.* ALL ADULT.

Cat. No. Stan. Univ. Mus.	4933	4936	4937	4939	4930	4932	4935	4940
Sex.	Male.	Male.	Male.	Male.	Female.	Female.	Female.	Female
Scales in circumference	74	72	72	76	70	68	68	70
Head and body, length	mm. 99	mm. 108	mm. 102	mm. 100	mm. 70	mm. 67	mm. 72	mm. 69
Tail, length	...	118	.....	112	...	91	63	71

TROPIDURUS PACIFICUS Steindachner.

Tropidurus (*Craniopeltis*) *pacificus* STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien, p. 313, pl. II, fig. 3, 1876.
Leiocephalus pacificus GÜNTHER, Proc. Zoöl. Soc., p. 67, 1877.
Tropidurus pacificus BOUL., Cat., II, p. 173, 1885, and Ann. N. H. (6), VII, p. 501, 1891.—COPE, Proc. U. S. Nat. Mus., XII, p. 147, 1889.—BAUR, Festschr. Leuckart, p. 270, 1892.
Tropidurus abingdonii BAUR, Biol. Centralbl., X, p. 477, 1890.

Range. — Galapagos Archipelago. Abingdon Island (Habel, Petrel, Albatross 1888, Baur, Hopkins Stanford Expedition).

Specific Characters. — Scales small, 94 to 101 in circumference of the body; dorsal scales little larger than the ventrals. Whole head reddish in both sexes.

Plates on top of head variable, the frontal small; prefrontals usually large, three or four in number; frontonasals two, the azygos plate between them and prefrontals small or wanting; prenasals not confluent with internasals. Supra-oculars wide, five or six; parietal bordered by two large temporals. Scales on body small, those on dorsal surface little larger than the laterals, equalling ventrals in size. Scales in circumference of body 94 to 101. Dorsal crest in male highest on tail, height at nape one half internasal distance.

Coloration in life of adult male, Cat. No. 4741, Stan. Univ. Mus. Dorsum grayish-brown, the back crossed by several series of transverse black bars, most distinct anteriorly, interrupted medially and on sides. Dorsal crest and the scales at its base light greenish-gray; dorsum, tail and limbs spotted with same. Top of head reddish-brown, nape olive-brown. Fore limbs brownish, barred above like the back. Tail becoming dusky toward tip, without lighter spots. Chin and sides of mandible pinkish; throat deep brown; chest light brown, dark-spotted, the scales with light margins; fore limbs below like chest, slightly more buffy. Belly, and hind limbs and tail inferiorly light olive-gray. Sides of head from snout to ear-opening red shading into seal brown on neck. A black antehumeral spot. Sides of body reddish, black-spotted.

Eight adult males are in the collection. In one specimen the breast and lower jaw are yellowish and the dark area of the throat restricted to a narrow band. Several have the top of the head spotted with light yellow and dark brown spots. Width of light area along base of dorsal crest variable. Light spots of dorsal surface nearly obsolete in some specimens.

Length of head and body 88 to 95 mm.

Coloration in life of adult female, Cat. No. 4740, Stan. Univ. Mus. Whole head, nape, shoulders, back anteriorly and sides of body brick red; fore limbs reddish, becoming olive-gray distally. Dorsal crest and median line of back greenish-gray; dorsum from middle of back, tail and hind limbs above olive-brown, spotted with the color of the dorsal crest. Belly, tail and hind limbs inferiorly light olive-gray. Breast and sides of body light brick red; throat dark red; lower jaw light like breast. Fore limbs below brick red proximally, lighter grayish distally. Antehumeral spot black.

The ten adult females in the collection show scarcely any variation in coloration. Breast in some indistinctly dark-spotted. Alcoholic specimens show no trace of the red on the top of the head.

Length of head and body 72 to 82 mm. The female approaches nearer the size of the male than in any other Galapagos species except *T. bivittatus*, which it nearly equals in this respect.

Proportions practically the same as in the other species of the Archipelago. In coloration this species is very different from any other. In the small size of the scales it is approached only by *T. duncanensis*.

Distributed abundantly over the brushy portions of Abingdon. Absent from the barren lava fields, even along the coast. Occurs from the beaches to the summit of the island but most abundant in the lower belt along the coast.

MEASUREMENTS OF *Tropidurus pacificus*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	4725	4731	4734	4735	4726	4730	4732	4739
Sex.	Male.	Male.	Male.	Male.	Female.	Female.	Female.	Female.
Scales in circumference	94	96	94	95	95	96	96	100
Head and body, length	mm. 191	mm. 88	mm. 94	mm. 95	mm. 80	mm. 82	mm. 82	mm. 72
Tail, length	126	...	151	...	...	123	110	107

Food chiefly vegetable, varied with insects, etc. Stomachs examined contained berries, hard seeds and blossoms with an occasional grasshopper, beetle or other insect. The seed capsules and berries are eaten for the fleshy part surrounding the seeds, which is the only part digested, the seeds passing unchanged through the alimentary canal. The same is true of all species of *Tropidurus* which eat seed capsules and berries.

Genus **Conolophus** Fitzinger.

Conolophus FITZINGER, Syst. Rept., p. 55, 1843.

Range. — Galapagos Archipelago.

CONOLOPHUS SUBCRISTATUS (Gray).

Trachycephalus subcristatus GRAY, Cat., p. 188.
Amblyrhynchus subcristatus GRAY, Zoöl. Misc., p. 6, 1831 and Zoöl. Beechey's Voyage, Rept., p. 93. — DARWIN, Journ. Beagle, p. 469.
Amblyrhynchus demarlii DUM. & BIBR., IV, p. 197. — BELL, Zoöl. Beagle, Rept., p. 22, pl. XII.
Hypsilophus (*Conolophus*) *demarlii* FITZINGER Syst. Rept., p. 55, 1843.
Conolophus subcristatus STEINDACHNER, Festschr. Zoöl.-Bot. Ges. Wien, p. 322, pls. IV–VII, 1876. — GÜNTHER, Proc. Zoöl. Soc., p. 67, 1877. — BOUL., Cat., II, p. 187, 1885. — GARMAN, Bull. Essex Inst., XXIV, p. 5, 1892 (part).
Conolophus subcristatus pictus ROTH & HART, Novit. Zoöl., VI, p. 102, 1899.

Range. — Galapagos Archipelago; Albemarle Island (Darwin, Hassler, Petrel) James Island (Darwin); South Seymour Islands (Hopkins Stanford Expedition); Narboro Island (Rothschild Expedition, Hopkins Stanford Expedition).

Formerly abundant on Albemarle, James, Indefatigable, Seymour and Narboro but now extinct on all except Seymour and Narboro, where they are still fairly common. Extinction due chiefly to the introduction of dogs which have destroyed both eggs and adults.

This species inhabits the brushy and wooded portions of the islands from sea-level to the rims of the highest craters.

Conolopus is an omnivorous vegetable feeder devouring almost any kind of vegetation. Grass, the foliage, flowers and berries of various bushes, and cacti (*Opuntia* and the fruit of the giant *Cereus*) are eaten with little or no preference. The reptiles when feeding climb into the bushes and strip the foliage from the branches, deftly crawling to the tips of slender branches for that purpose.

They live in burrows dug obliquely into the soil in open country or on rocky hillsides often beneath or between the lava rocks. All the individuals we observed were somewhat shy and would scamper to their burrows as soon as alarmed. This is undoubtedly an acquired habit due to their persecution by dogs.

MEASUREMENTS OF *Conolophus subcristatus*. ALL ADULT.

Locality.	Narboro.				South Seymour.						
Cat. No. Stan. Univ. Mus.	4798	4791	4787	4789	4795	4794	4797	4788	4792	4793	4790
Sex.	Female.	Male.	Male.	Female.					Female.	Female.	Female.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	390	400	405	380	405	475	480	440	455	415	425
Tail, length	480	475	495	325	470	520	465	450	515	480	465
	%	%	%	%	%	%	%	%	%	%	%
Snout to ear[1]	18	19	21	18.5	20	20	18.5	18.7	21.5	20	19
Snout[2]	48	46	46	45	47	46	48	49	44	48	46
Width of head[2]	81	85	81	81	80	88	80	80	84	79	82
Fore limb[1]	40	41	45	43	39	40	39	36.5	46	41	37.5
Hind limb[1]	55	52	56	52	52	51	50	48	56	53	49
Femoral pores	20/21	25/23	21/22	19/21	21/23	17/19	17/18	18/19	21/22	20/20	15/15

[1] Percentages of length of head and body.

[2] Percentages of length of head, snout to ear.

Our material consists of four adult specimens from Narboro and seven from South Seymour. The coloration of the two series shows scarcely any constant differences, but there is considerable individual variation.

Coloration in life of adult male, Cat. No. 4787, Stan. Univ. Mus., from Narboro, March, 1899. Superior and inferior labials, oculars and sides of snout to level of nostrils lemon; head above orange with spots and blotches of whitish; neck, lower jaw and throat dirty whitish; dorsum upper surface of limbs and tail brick red; lower parts, excepting tail posteriorly, chrome; tail posteriorly lighter brick red; dorsal crest on nape lemon, on dorsum brick; tympanum lemon with a bluish semicircle; iris ochraceous and silvery; claws light brownish-yellow.

An adult female, Cat. No. 4489, Stan. Univ. Mus., same locality and date, was similar in coloration to the male but dorsum much darker, maroon rather than brick, black-blotched; no white on head above; whitish of throat extending on breast to beginning of belly; drab blotches on rump, hind limbs and tip of tail; fore limbs chrome above, not like dorsum; legs and tail black-spotted like dorsum.

CONOLOPHUS PALLIDUS sp. nov.

Conolophus subcristatus GARMAN, Bull. Essex Inst., XXIV, p. 5. 1892 (part).

Type.—Adult female, Cat. No. 4749, Stan. Univ. Mus.; Barrington Island, Galapagos Archipelago, May, 1899.

Range.—Galapagos Archipelago; Barrington Island (Baur, Hopkins Stanford Expedition).

Specific Characters.—Coloration above, clay yellow, below, whitish; rostral plate broad, height more than twice the length, bordered above by eight scales; snout less than twice in length of head from ear-opening; height of mental twice in the width.

Description of the Type.—Head short, occipital region highest, depressed anteriorly at occipital plate; interorbital flat; profile of snout convex. Head widest between ear-opening and angle of jaws, width one and one third in the length. Ear-opening broadly oval, a little larger than the eye, bordered by small scales. Nostrils large, circular, perforating a single raised plate, nearer snout than eye; distance from snout to center of nostril equal length of rostral plate. Head covered above by keeled convex scales, those on occiput strongly conical; occipital plate not much enlarged; supraoculars small; scales anterior to nostrils without keels. Rostral plate large, broadly pentagonal, height more than twice in the length, bordered above by eight scales. Superior labials 10–11, as wide as high. Mental plate broadly triangular, height twice in the length, as long as rostral, bordered posteriorly by four submentals, the two inner much larger; inferior labials 11–12, similar in shape to superior labials. Chin and throat covered with small scales, the chin with a median groove from angle of mental; throat and chin longitudinally plicate. Dorsal surface with small conical, sharply pointed scales, those on superior and anterior surfaces of limbs larger; toes above with enlarged median lamellæ distally. A dorsal crest of enlarged scales from nape to tail; highest on nape where represented by nine high conical scales; lower and more uniform on dorsum, where composed of slightly compressed conical, juxtaposed scales, highest anteriorly, becoming obsolete between hind limbs and reappearing again on tail. Lower surfaces covered with larger, squarish, smooth scales, those before anus smaller and rounded. Inferior and posterior surfaces of limbs covered with small scales, these beginning on hind limbs abruptly at femoral pores; toes inferiorly with a median series of enlarged tricarinate lamellæ, thirty-one under fourth toe. Tail rounded, tapering gradually, covered with large, square, obliquely keeled scales; crest obsolete on posterior part. Femoral pores 22–23.

Coloration in Life. — Above light clay yellow, a large light-brown blotch between hind limbs, another across middle of back; toes more brownish toward tips; below cream, axilla and groins pinkish; whole neck and eyelids bluish; labials and sides of head blotched with grayish and yellow.

Variations. — Height of dorsal crest and convexity of scales on top of head varies with age. In immature specimens they are much lower. Superior labials nine to eleven, usually ten; inferior labials nine to thirteen. Femoral pores 20–24. Brown blotches on dorsal surface vary much in extent, absent in some specimens; appear to be due to shedding. Coloration of underparts cream-yellow to pinkish-cream; bluish of neck and labials most marked in immature specimens. Young vermiculated with dark brown on an olive-yellow ground; below light yellowish.

Close to *C. subcristatus* from which it differs in its paler coloration, lacking the chrome-yellow head and limbs and dark red dorsum of that species. The mental and rostral plates are wider, also.

Six specimens collected. Rather sparingly distributed in small colonies throughout the islands. Many of the dried skins found near an old camp where the lizards had been used as food by the Ecuadorians. This would account for the scarcity of the reptiles on the island.

MEASUREMENTS OF *Conolophus pallidus*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	4749	4770	4766	4768	4765
Sex.	Female.	Female.	Female.	Female.	Male.
	mm.	mm.	mm.	mm.	mm.
Head and body, length	375	355	330	325	325
Tail, length	515	450	455	445	445
	%	%	%	%	%
Snout to ear	20.5	21	20	21	21
Snout	49	48	49	48.5	51
Width of head	77	80	74	80	77
Fore limb	43	50	44	47	48
Hind limb	61	59.5	62	66	65

Percentages as in table of measurements of *C. subcristatus*.

Genus **Amblyrhynchus** Bell.

Amblyrhynchus BELL, Zoöl. Journ. II, p. 206, 1825.

Range. — Galapagos Archipelago.

AMBLYRHYNCHUS CRISTATUS Bell.

Amblyrhynchus cristatus BELL, Zoöl. Journ., II, p. 206, 1825, Suppl., pl. XII, and Zoöl. Beagle Rept., p. 23. — DUM. & BIBR., IV, p. 195, 1837. — DARWIN, Journ. Beagle, p. 466. — A. DUM., Cat. Meth., Rept., p. 62. — STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien. p. 316, pls. III, V, VI, VII, 1876. — GÜNTHER, Proc. Zoöl. Soc., p. 67, 1877. — BOUL., Cat., II, p. 185, 1885. — COPE, Proc. U. S. Nat. Mus., XII, p. 147, 1889. — GARMAN, Bull. Essex Inst., XXIV, p. 7, 1892 (part).
Oreocephalus cristatus GRAY, Cat., p. 189, 1845.
Iguana (*Amblyrhynchus*) *cristatus* GRAY, Griff. A. K., IX, Syn., p. 37.
Iguana (*Amblyrhynchus*) *ater* GRAY, Griff. A. K., IX, Syn., p. 37.
Amblyrhynchus ater DUM. & BIBR., p. 196.
Hypsilophus (*Amblyrhynchus*) *cristatus* FITZINGER, Syst. Rept., p. 55, 1843.
Hypsilophus (*Amblyrhynchus*) *ater* FITZINGER, Syst. Rept., p. 55, 1843.
Amblyrhynchus cristatus var. *ater* GARMAN, Bull. Essex Inst., XXIV, p. 8, 1892.
Amblyrhynchus cristatus var. *nanus* GARMAN, Bull. Essex Inst., XXIV, p. 8, 1892.

Range. — Galapagos Archipelago: Albemarle (Petrel, Baur, Hopkins Stanford Exped.); Charles (Petrel, Baur); Hood (Albatross 1888, Hopkins Stanford Exped.); Chatham (Albatross 1888); Indefatigable (Hopkins Stanford Exped.); James (Albatross 1888); Duncan (Albatross 1888, and Hopkins Stanford Exped.); Narboro (Hopkins Stanford Exped.); Tower (Baur, Hopkins Stanford Exped.); Bindloe (Baur); Abingdon (Petrel, Albatross 1888); Wenman (Hopkins Stanford Exped.); Culpepper (Hopkins Stanford Expedition).

We observed the species on all the islands and islets of the archipelago. They occur abundantly on every island, living upon the rocky beaches, their dark colors harmonizing well with the black basaltic rocks. In some localities they occur so numerously as to more or less completely hide the rocks near the beach.

Their food consists chiefly of marine algæ, both Chlorophyceæ and Phæophyceæ, which is obtained by diving in quiet coves and lagoons. In such sheltered places they can usually be seen cropping the algæ from the rocks which pave the bottom. After partaking of a sufficient quantity they return to the beaches and crowd upon the bowlders near shore where they spend most of their time basking in the sunshine.

They seldom go far out to sea, usually remaining within a hundred yards of the beach. None were seen in the open channels between the islands and it is probable that they do not usually leave the island on which they were reared. When attacked they slip lazily into the water, but soon return to the land which they regard as the safest place. Their chief enemies are the sharks (*Carcharrhinus*) which patrol the shore line and act as checks to the migration of the species. The remains of *Amblyrhynchi* were not uncommon in the stomachs of the sharks we dissected. It is probable that the Galapagos hawk, *Buteo*, eats the young when first hatched as in the case of the young of *Testudo*.

The eggs are deposited at the end of the rainy season in the sand near the beach, usually in bowlder-strewn places. A nest found at Iguana Cove, Albemarle, and from which the female was driven was situated in the sand which partially filled a fissure in the lava rocks bordering the beach. The eggs in this nest were six in number, soft-shelled, elliptical and measured approximately three inches in length by one and a half in diameter.

Much individual variation occurs, especially in size and coloration together with a slight amount of local variation. In coloration the variation extends, on nearly every island, from black specimens through brownish to greenish-mottled and to a combination of mottlings of all three colors. The young are uniform black above, the mottled coloration not being attained until they reach a length of a foot or more. The immense specimens at Iguana Cove have little black on them, the general coloration above being greenish and brownish blotches. The variation in size among adults is considerable but difficult to determine. The convexity of the head plates and the height of the dorsal crest varies from the smooth condition and low crest of the young to the sharply conical plates and high crest of the old adults.

MEASUREMENTS OF *Amblyrhynchus cristatus.*

Locality.	Narboro.		Albemarle. Iguana Cove.	Albemarle. Tagus Cove.	Duncan.	Seymour.		Hood.		Tower.	Culpepper.		Wen-man.
Cat. No. Stan. Univ. Mus.	4782	4781	4784	4744	4778	4783	4775	4771	4779	4786	4776	4780	4777
Sex and Age.	Adult Male.	Adult Female.	Adult Male.	Adult Male.	Adult Female.	Adult Male.	Adult Male.	Young.	Young.	Young	Adult Male.	Adult Male	Adult Male.
	mm.	mm.	mm.	mm	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length..	310	253	475	345	290	330	350	190	222	165	287	310	248
Tail, length..................	494	380	660	562	412	.....	485	315	.....	268	420	490	380
	%	%	%	%	%	%	%	%	%	%	%	%	%
Snout to ear[1]...............	17.5	17.3	18	19	16	16.5	16.5	18	17	17.3	17	17	17
Snout[2]........................	55	54	56	56	54	53	55	57	56	55	57	57	56
Width of head[2]...........	98	98	105	98	94	96	100	94	95	93	98	102	95
Height of crest[2] on nape	44	25	41	41	32	45	37	29	27	17	33	25	35
Fore limb[1]..................	44	41	40	43	43	42	38	46	41	45	44	43	45
Hind limb[1]............	58	63	55	63	57	55	55	63	62	61	60	59	65
Femoral pores.............	24	26	24	27	.....	25	23	28	25	27	27	29	23
	25	25	21 +	24	.....	25	23	27	28	29	27	31	25

[1] Percentages of length of head and body.
[2] Percentages of length of head, snout to ear.

The local variation is slight and so mixed with individual variation that it is difficult to define. With only our scanty material for comparison — eighteen specimens representing eight islands — we have not been able to detect any insular varieties nor would our observations in the field lead us to infer that any well marked forms exist.

The proportions are practically the same in all the specimens. The largest specimens occur at Iguana Cove, where some attain a length of four feet. Nowhere else do they attain these dimensions. On Culpepper, Wenman and Tower they appear to average smaller than on any of the other islands.

The Duncan variety which has been described as uniform black above has received the name *ater*. Our only specimen from Duncan, an adult female, is no darker in coloration than specimens from other islands, being blotched with greenish on the dorsum and mottled with brownish on the sides. Those observed on the island were not noticeably darker than those seen on other islands.

A single young specimen of the variety called *nanus* from Tower Island is in the collection. The individuals observed at Tower appeared somewhat smaller and darker, on an average, than those from other islands but exceptions in size were not rare.

Hood Island possesses the lightest forms. Two specimens in the collection have the dorsum covered by a few large confluent light greenish blotches, the head blackish and the sides and limbs mottled with black and brown in about equal proportions. Nearly all the specimens seen were remarkably light-colored and this coloration is attained in this locality at an early age.

The specimens taken on Culpepper and Wenman, though separated in habitat from the others by a considerable expanse of ocean, are not appreciably different. They average smaller, with less convexity to the plates on the top of the head and snout and with smoother dorsal scales. The green blotches are entirely lacking on the dorsum the upper parts being black, spotted and mottled with brown. Some specimens, however, from the Seymour Islands duplicate these in coloration.

Occasional migration at rare intervals probably occurs between all the islands which keeps the stock apparently the same.

Genus **Dromicus** Bibron.

Dromicus Bibron, in R. de la Sagra Hist. Cuba Erp., p. 221, 1843 (part).

Range.—West Indies and west coast of South America from Peru to Chile. Galapagos Archipelago (a single species and subspecies).

DROMICUS BISERIALIS BISERIALIS (Günther).

Herpetodryas biserialis GÜNTHER, Proc. Zoöl. Soc., p. 97, 1860.
Dromicus chamissonis PETERS, Mon. Berl. Ac., p. 719, 1869.—BOUL., Cat., II, p. 119, 1894 (part).
Dromicus chamissonis var. *biserialis* GÜNTHER, Zoöl. Rec., p. 115, 1869 (part).
Dromicus chamissonis var. *dorsalis* STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wien, p. 306, pl. 1, fig. 1, 1876.
Opheomorphus chamissonis COPE, Proc. U. S. Nat. Mus., XII, p. 147, 1889 (part).
Orophis biserialis GARMAN, Bull. Essex Inst., XXIV, p. 85, 1892 (part).

Range. — Galapagos Archipelago; Charles (Darwin, Hassler); Indefatigable (Hassler); James (Hassler, Albatross 1888); Albemarle (Hassler, Hopkins Stanford Exped.); Narboro (Hopkins Stanford Expedition).

Specific Characters.—Close to *D. chamissonis*, from which it is doubtfully distinct, differing chiefly in the greater number of gastrosteges, 209–252 (175–201 in *D. chamissonis*) and in the shorter prefrontals which equal or but slightly exceed the internasals in length.

The coloration above is dark olive, either uniform or dark-blotched and spotted on nape, or with a pair of light brownish longitudinal dorsal stripes covering the third and fourth scale rows. These begin three or four inches posterior to the head and extend to the tail, the stripes anteriorly represented on the nape by a series of spots of the same color. Head and throat below thickly dark-spotted.

Oculars 1–2, rarely 1–3; temporals usually 1–2–3. Two specimens have a few of the dorsal scales marked with double scale-pits but none of the others shows this character.

One specimen, Cat. No. 4977, Stan. Univ. Mus., taken on Albemarle, near Cape Berkeley, had the following coloration in life: above brown, the scales minutely dark-dotted; two longitudinal series of black spots on sides of body; neck above lighter brownish-yellow with a median black stripe and a single series of large black blotches; top of head spotted minutely with light yellowish; tail unspotted, becoming lighter toward the tip; sides of head about labials light with darker brownish spots; belly pink with a steel gray luster, darkly spotted on sides; throat and mandible more grayish, thickly dusky-spotted; tail light yellowish inferiorly.

Most of the Narboro specimens have the light dorsal stripes very distinct; one specimen, however, is uniform dark brown above and another resembles the Albemarle specimen in coloration. A young specimen from this island has a color pattern quite different from any of the others. Its general coloration above is dark brown, the sides and dorsum barred with light brownish bars forking on sides, anteriorly nearer together and nearly meeting over the nape, posteriorly breaking up on the sides of the tail into spots.

According to Steindachner *D. biseralis habeli* stands nearest the continental form in coloration. From descriptions of the coloration of *D. chamissonis* it appears that the species is very variable in coloration and is as often blotched or striped above on a dark ground. *D. biseralis* has the reverse condition as in the Hood Island forms.

MEASUREMENTS OF *Dromicus biserialis biserialis.*

Locality.	Narboro.			Albemarle.	
Cat. No. Stan. Univ. Mus.	4973	4974	4975	4976	4977
Oculars	1–2	1–2	1–2	1–2	1–2
Temporals	1–1–2 / 1–2–3	1–2–3 / 1–2–3	1–2–3 / 1–2–3	1–2–3 / 1–3–4	1–2–3 / 1–2–2
Lower labials touching pregenials	5–5	5–5	5–5	5–5	4–4
Gastrosteges	252	231	233	243	241
Urosteges	91	116	112	105	87
	mm.	mm.	mm.	mm.	mm.
Length, total	975	700	820	466	1090
" tail	205	275	285	145	230

DROMICUS BISERIALIS HABELI (Steindachner).

Dromicus chamissonis var. *habelii* STEINDACHNER, Festschr. Zoöl.-bot. Ges. Wein, p. 309, pl. 1, fig. 2 ,1876.
Orophis biseralis GARMAN, Bull. Essex Inst., XXIV, p. 12, 1892 (part).

Range. — Galapagos Archipelago; Hood Island (Habel, Baur, Hopkins Stanford Expedition).

Subspecific Characters. — Coloration above light grayish-olive with a pair of whitish longitudinal stipes covering third and fourth scale rows, beginning behind eye and becoming obsolete a little posterior to middle of body. Head below light greenish-gray sparingly spotted with dusky. Oculars 1–3; temporals 2–2 (3)–3.

MEASUREMENTS OF *Dromicus biserialis habeli.*

Cat. No. Stan. Univ. Mus.	4970	4971
Oculars	1–3	1–3
Temporals	2–3–3 / 2–2–3	2–2–3 / 2–2–3
Lower labials touching pregenials	4–4	5–5
Gastrosteges	212	206
Urosteges	94	98
	mm.	mm.
Total length	965	745
Tail	230	205

Two specimens are in the collection from Hood Island. These differ conspicuously in coloration from those specimens secured on other islands and represent a well-marked color variety which is undoubtedly confined to Hood.

Genus **Anolis** Daudin.

Anolis Daudin, Rept., iv, p. 50, 1802.

Range. — Tropical and subtropical America.

ANOLIS TOWNSENDI Stejneger.

Anolis townsendi Stejneger, Bull. Mus. Comp. Zoöl., xxxvi, p. 163, 1900.

Range. — Cocos Island. Common on vegetation and rocks everywhere.

A typical specimen, an adult male, Cat. No. 4537, Stan. Univ. Mus., shows the following characters: head narrow; the snout sharp, rounded at tip, depressed, the profile concave before eyes; occipital region flat; interorbital concave; canthus rostratus distinct nearly to nostrils, covered by six scales; nostrils lateral, separated by seven rows of scales; eye one and one half in interorbital width; ear opening elliptical, vertical, smaller than occipital plate, bordered by rounded granules; snout covered with keeled scales; rostral broad and low, rectangular, height two and one half times in length; superior labials six before middle of pupil; six loreals in a vertical series before eye; fifteen enlarged, keeled supraoculars; two rows of scales between supraorbitals; four rows between occipital and supraorbitals; mental deeply cleft, elongate, extending on sides considerably past the rostral, bordered posteriorly by six rows of chin scales, the median ones keeled, outer larger, without keels; inferior labials six before pupil, similar in shape to superior labials; mandible covered with small oval keeled scales; gular-sac large, reaching from chin to end of sternum; teeth posteriorly trilobate, anteriorly becoming more slender and losing the lateral cusps; no pterygoid teeth.

Dorsum covered with juxtaposed keeled scales larger than the raised granules of the sides; vertebral series enlarged. Ventral scales keeled, larger than the dorsals, imbricate, those on the gular-sac larger with smaller keels; smaller on groins and inferior surfaces of limbs. Toes covered inferiorly with a median series of transverse lamellæ. Tail covered dorsally with keeled scales, larger than those on the back, the median series enlarged; inferior surface of tail covered with keeled scales similar in size to those on superior surface; no enlarged postanal scales. Limbs armed on their dorsal and anterior surfaces with imbricate, sharply keeled scales, larger than the dorsals and much larger than the granular scales of the posterior surfaces; phalanges superiorly with a median series of large multicarinate scales; third and fourth phalanges of fourth toe with seventeen lamellæ inferiorly; penultimate phalanx of each toe dilated. Extended fore limb reaching midway between nostril and eye; appressed hind limb reaching anterior border of eye. Tail long, cylindrical, length twice head and body.

Coloration in Life. — Above olive-brown with transverse mottlings of darker brown, limbs and tail barred with the same; sides with a bright green longitudinal stripe beginning below ear, running obliquely above shoulder to thigh, bordered above and below by dark brown stripes equal in width to light stripe; another narrower stripe similar in coloration commencing above ear and extending obliquely to above shoulders. Belly and chin whitish; limbs, groins and tail inferiorly light olive with faint dusky blotches; gular-sac orange, finely white-spotted. Iris black with a narrow golden ring bordering the pupil; eyelids edged with golden.

Variations. — Rows of scales between supraorbitals two or three, between occipital and supraorbitals three or four; loreals in five or six vertical rows before eye; supralabials six or seven before middle of pupil; transverse lamellæ on inferior surfaces of second and third phalanges of fourth toe seventeen to nineteen. Coloration on upper parts varying from light to dark olive, the lateral stripes varying considerably in extent and intensity; whole lower surface of some specimens olivaceous, only the mandible whitish.

MEASUREMENTS OF *Anolis townsendi*. ALL ADULT.

Cat. No. Stan. Univ. Mus.	4537	4536	4545	4542	4543	4544	5538	5441
Sex.	Male.	Male.	Male.	Male.	Male.	Female.	Female.	Female.
Head and body,	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
length	49	42	46	44	46	40	41	42
Tail, length	..	84	96	...	..	73	...	...
	%	%	%	%	%	%	%	%
Snout to ear[1]	28	32	29	31	30	31	29	29
Snout[2]	53	55	55	55	55	58	58	55
Width of head[2]	56	55	55	55	55	58	60	58
Tibia[2]	92	96	91	95	95	100	95	91
Fore limb[1]	39	47	45	47	43	45	44	43
Hind limb[1]	75	87	82	85	82	95	88	80

[1] Percentages of length of head and body.

[2] Percentages of length of head, snout to ear.

Females with a trace of the gular-sac of the male; no enlarged vertebral scales and tail usually without the median dorsal series enlarged. Coloration similar to that of the male but somewhat duller, lacking the orange coloration of the gular-sac.

Eleven specimens are in the collection from Cocos Island.

Genus **Lygosoma** Gray.

Lygosoma GRAY, Zoöl. Journ., III, p. 228, 1828.

Range.— Tropicopolitan. Clipperton Island (one peculiar species).

LYGOSOMA ARUNDELI Garman.

Lygosoma arundelii GARMAN, Proc. N. Eng. Zoöl. Club, I, p. 61, 1899.

Range.— Clipperton Island. Occurs abundantly on Clipperton Rock, which forms a small projection near the center of the coral atoll.

Fifteen specimens are in the collection. These agree minutely in squamation with the descriptions of Polynesian specimens of *L. cyanurum* (Lesson) but differ somewhat in coloration. The light stripes of this latter species are represented by a single median light stripe. In the suppression of the lateral light stripes the species approaches some specimens of *L. cyanurum* from the Hawaiian Islands described by Stejneger.[1] The species is of doubtful validity but in the absence

MEASUREMENTS OF *Lygosoma arundeli.*

Cat. No. Stan. Univ. Mus.	4969	4961	4960	4962	4959	4968	4955	4964
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Head and body, length	50	48	50	45	50	48	45	47
Tail, length	74	74	80	69		72	63	66
	%	%	%	%	%	%	%	%
Snout to ear[2]	24	25	24	23	23	25	24	22
Snout[2]	12	11	12	11	12	11	12	11
Width of head[2].	16	17	17	16	16	17	15	15
Fore limb[2]	31	28	28	28	30	32	29	28
Hind limb[2]	44	43	42	40	43	44	43	40
Scales in circumference of body	28	30	26	28	28	32	28	30
Subdigital lamellæ	63	60	60	52	63	60	56	53

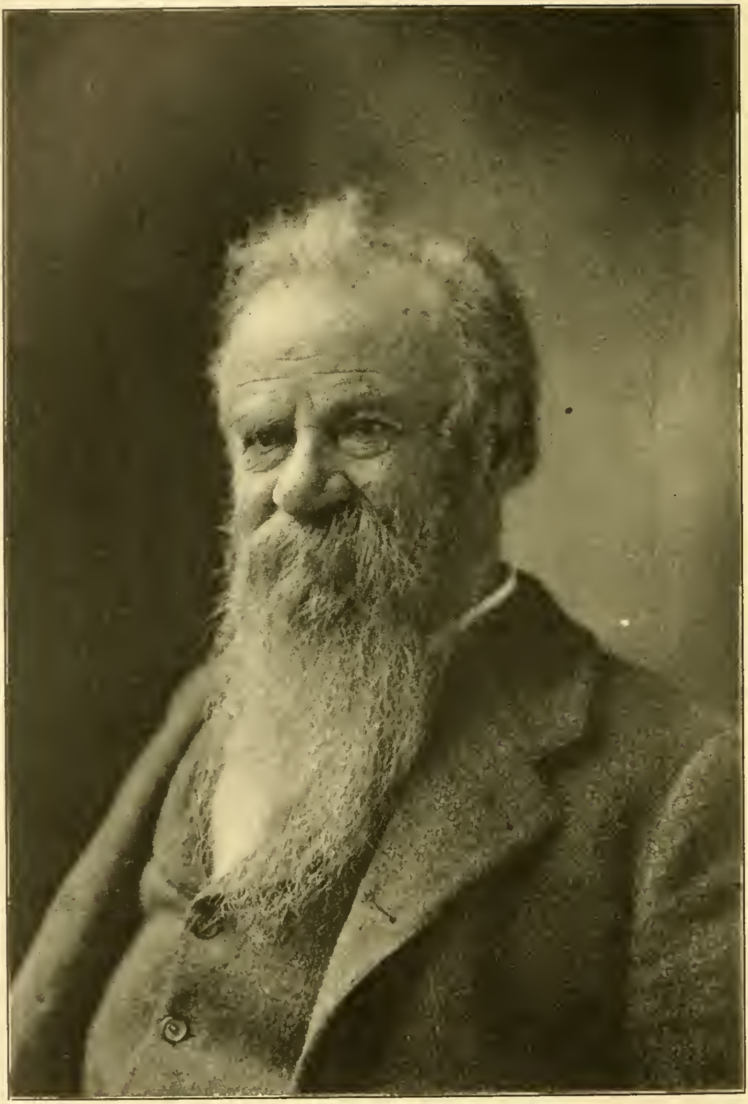
No. 4969. Right prefrontal coalesced with frontal.
Nos. 4955, 4959, 4961. Frontal touching fronto-nasal.
No. 4962. Frontal coalesced with prefontals.
Nos. 4960, 4964, 4968. Frontal not touching fronto-nasal.

[1] Stejneger (L.), Hawaiian Land Reptiles. Proc. U. S. Nat. Mus., vol. XXI, p. 807, 1899.

[2] Percentages of length of head and body.

of series of specimens from other localities for comparison its status cannot be determined.

Variations.—Coloration dark lustrous brown above with a whitish median stripe from snout to rump, beginning definitely in middle of frontal, but usually traceable to frontonasal (scarcely any variation from young to adult in intensity of this stripe). Median stripe bordered on each side by a band of dark brown as wide as the light stripe. Below light grayish or whitish with olive tinge, darkest on sides of belly; lower jaw with dusky blotches medially; tail blue-gray below, brownish like back above. One adult specimen is uniform dark bronze-brown above, lacking the median light stripe but with the darker bordering stripes fairly indicated. In some specimens the lower parts are brownish without whitish anywhere, the mandible and throat being quite dark and the tail more bluish below.



Yours Cordially
J W Powell

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. V, pp. 99–187. [plate I] July 18, 1903.

JOHN WESLEY POWELL.

PROCEEDINGS OF A MEETING COMMEMORATIVE OF HIS DISTINGUISHED SERVICES

Held in Columbian University under the Auspices of the Washington Academy of Sciences,

February 16, 1903.

CONTENTS.

The President of the Academy, Mr. Charles D. Walcott, said:

We have come together tonight to honor the memory of John Wesley Powell, soldier, teacher, explorer, geologist, anthropologist, organizer and administrator of institutions, and a broad-minded, kindly natured man. He became distinguished both as a direct, personal contributor to science and philosophy and as a creator and administrator of organizations which have made and will continue to make large contributions to knowledge; and it is yet too early to say in which of these lines his service to mankind was the more valuable. Today the popular verdict would be in favor of the latter, the results of which are known of all men; but there are those who believe that his personal contributions to science and philosophy will be better understood and therefore more appreciated by future generations than they are by most of us today, and whose greatest regret is that physical disabilities and suffering prevented him from leaving on record all the conclusions of his ripest thought.

It is of Major Powell's service in organizing and directing the work of others and inspiring them to their best endeavors that, did time permit, I would speak on this occasion. There are administrators who achieve a fair amount of success through securing from the organization economical and efficient work along prescribed lines. These are, properly speaking, executives. There are administrators of another kind, who possess insight and creative ability, who have scientific imagination and the power of initiative. Their conceptions are broad and clear; they are not only masterful in execution, but fertile in suggestion and potent with the authorizing power. Among this class Major Powell was eminent.

These qualities were early discovered by General Grant, who consigned to this young engineer and artillery officer important military duties. Perhaps it was at Shiloh, around Vicksburg, and in other battles and sieges that he learned the lesson of the power of organized forces. Of his military life General David B. Henderson will speak.

POWELL AS A SOLDIER.

Mr. Henderson said:

Mr. Chairman, Ladies and Gentlemen: I have never preached a funeral sermon, but I should like to preach one tonight. If I could burn into human hearts something of the life and character of J. W. Powell I would be happy.

I am assigned to "Powell as a soldier," and I see from the program that Professor Langley is assigned to "Powell as a man." I felt rather hurt when I observed this arrangement. How can I talk of J. W. Powell, the soldier, when I hate soldiers? I have a supreme contempt for the soldier without the man. Take away the soldier and you may have left a philanthropist, a philosopher, a lover of his race; but take away the man from the soldier and you may have left a sort of panther, a hyena, a something that wants to fasten its bloodthirsty fangs upon a fellow man. I will have difficulty in confining myself to "Powell the soldier."

I was with him at the battle of Pittsburg Landing, where he lost his arm. But you can not tell anything about a man in battle. There he may seem to be utterly merciless and blood thirsty. In order to properly judge of a man it is necessary to know him outdoors and indoors — in the camp and the field, on the highway and in the byway, by the forest and along the stream, and it is especially necessary to know him in his family.

During the World's Fair, having been chosen by the old Society of the Army of the Tennessee, of which Major Powell was a member, to deliver the annual address, my theme was "War." When I addressed them I said: "My theme is 'War,' and I'm against it! Yes, looking down into the old bronzed faces of you men who fought with the armies of Grant and Sherman, I tell you I am against it." One day when I was riding around this city with Major Powell, he referred to that speech, and told me that he had quoted largely from it in one of his papers. He said that in that speech I had touched the key to his heart. He was not an admirer of Napoleon, or Cæsar, or any of the great slaughterers; but oh, how illumined and beautiful became that rugged, bearded face when he talked of Abraham Lincoln!

Now Bessie Beech has the true conception of Major Powell. She pays this tribute to the Major: "He enlisted with the avowed purpose of doing his part in the extinction of slavery in this country; and from the first day after the call was made for troops, he felt thoroughly convinced that American slavery was doomed. He found reasons later in life for enlarging his opinions regarding the importance of the issue at stake; for he says in a letter to a friend: 'It was a great thing to destroy slavery, but the integrity of the Union was of no less importance.'" Note well his words. Most of us would have said "was of far greater importance than the destruction of slavery," but he puts it "of no less importance." God bless your memory, Major Powell, you understood that war! But let him speak for himself: "'And beyond it all was to be counted the result of the war as an influence which should extend far into the history of the future, not only establishing in North America a great predominating nation, with a popular and powerful government, but also securing the ascendency of the Anglo-Saxon branch of the Aryan family, and the ultimate spread of Anglo-Saxon civilization over the globe. Perhaps it is only a dreamer's vision wherein I see the English language become the language of the world, of the science, the institutions, and the arts of the world, and the nations integrated as a congeries of republican states.'"

A man that fights with another just because he feels like it, without an analysis of that feeling, is not a worthy example to follow. That rugged boy from Illinois saw, through the dark clouds overspreading the Republic, the smiling face of God bringing liberty to man, and then he offered his life to help to make that certain.

I have written out the military history of Major Powell, but the dry details are not what you want tonight. I very seldom write speeches, for I can not get close enough to my audience if I write out a speech, and tonight I want to get close to you, to be a part of you, to live and think and feel with you, for the life of Major Powell is a poem.

Powell enlisted as a private soldier. He did not wait until he could get a strap or bar, a silver leaf, a gold leaf, an eagle, or a star, but after he had studied the conditions and knew what the war meant he went right in. From August 7 to 10, 1861, he was with an expedition to Price's Landing, Commerce, Benton, and Hamburg, Missouri; from August 28 to September 5, 1861, he took part in the operations in southeast Missouri; from September 13 to 20, 1861, he was at the siege of Lexington, Missouri; October 2, 1861, with an expedition from Bird's Point to Charleston, Missouri; April 6, 1862, at the battle of Shiloh, Tennessee, a bloody field. I remember riding over it for hours to find comrades. I had a brother shot through the heart there, and did not know it until two days afterwards, when they brought his body in an ambulance and laid it at the door of my tent. Riding for hours on that field, there was not a moment when I could not see human forms stretched upon the ground, many of them still struggling for life. It makes a man hate war to see such sights — to ride by and hear the poor boys crying for their mothers in tones that must have made the angels weep. That field was where this man played a glorious part, losing his right arm. This injury incapacitated him for active service for several months. From January 19 to July 4, 1863, he took a conspicuous part in the siege of Vicksburg, Mississippi; from February 3 to March 6, 1864, he was with an expedition to Meridian, Mississippi, and from September 29 to November 31, 1864, he took part in the campaign in northern Georgia and northern Alabama. Such is the account in brief.

Powell enlisted at the beginning of the war on May 8, 1861, as a private soldier, but before his company was mustered into the United States service the governor of Illinois commissioned him to be a second lieutenant. He was a scientific soldier. While sergeant-major in the Twentieth Illinois he obtained permission to go to Chicago to get a copy of the tactics, which he studied. His previous study had made him a good civil engineer. This was evidenced at Cape Girardeau, when, in the fall of 1861, he was detached from his command in order to plan the camp and entrenchments and to fortify the city. There he had wide experience, and attracted the attention of General Grant. It was his desire to give up the engineering work and return to his regiment, but General Grant had other plans for him, and made him a captain of artillery. In his campaign up the Tennessee River he had an excellent battery, made up of fine-looking, well-drilled, capable men. At Shiloh, as I have already said, he and his battery played a glorious part. After recovering from the wound and returning to his battery, he entered enthusiastically into the siege of Vicksburg.

It is hard to properly measure the value of this young engineer's services in planning the siege works. The bridges he built and the corduroy roads he laid out, and the consequent success with which the troops were transported across the country, so difficult to traverse because of the swamp lands, were tributes to his great ability and untiring energy. On the march toward Vicksburg, Captain Powell took part in the battles of Champion Hill and Black River Bridge. It is thrilling to read the story of the building, by him and his men, of the two bridges across Black River, after the battle of Champion Hill, thus enabling two divisions of the Union Army to cross. It is said that the busiest days of his life were the thirty or more prior to the fall of Vicksburg, when he was working day and night with plans and helping the men to carry them out. His efforts in the siege work at Vicksburg attracted the attention of Generals Grant, McPherson and Ransom.

After the fall of Vicksburg, Captain Powell went to New Orleans on an important mission, that of transporting cattle that had been captured at Natchez, to feed the Union troops there, part of the number having been sent to Vicksburg.

Let me say a word about Mrs. Powell. There are soldiers and there are soldiers, but the great heroes of the civil war were our women. The mothers and wives were those who made sacrifices in the civil war. One day Major Powell was riding with General Grant, who early discovered Powell's great genius for engineering, and he said: "General, I should like to go to Detroit and get married." He had been engaged for a long time to a girl there — Miss Emma Dean. The General gave him the leave of absence, and he started at once for Detroit. He reached there about 8 o'clock in the evening, was married, and in a few hours was on his return trip to the seat of war, accompanied by Mrs. Powell; and when that little fellow had his arm shattered, resulting in amputation, he would have gone where many of the boys went at Shiloh — to his grave — but for that tender, loving, devoted wife, who stayed with him and nursed him through every hour of his suffering. And Mrs. Powell nursed not only her dear husband, but wherever her hand and smiling face could minister to a sick or a dying man, there she was to be found.

May I repeat a page of my own life with the Major. It will tell you of him more than of me. Some years ago, in this city, I suffered for a long time from an old wound received at Corinth. At last a very serious operation became necessary. I did not have a horse and carriage, and one day this bearded fellow, with his one arm, called and said: "Mr. Henderson, I have a good horse and buggy — nothing fancy — but I should like very much to take you out on these sunny days and give you a little air and sunshine;" and he named the time when he would call for me. He came at the time appointed, and with the aid of others — I was not able to walk with my crutches — assisted me into the buggy; and thereafter, for days and weeks, we traveled slowly over the best streets of the city. Gradually the life seemed to flow back into my heart. Do you know that during those weeks of tender love — all of a brother's love — I bathed every day in the warm, gently-flowing streams of a great mind. Then it was that I got a grand view of Powell the tender, sympathetic man.

By War Department order issued January 14, 1865, Major Powell was honorably discharged, and thus was brought to a close a military service which was conspicuous for achievements in the artillery branch and in engineering feats. He returned to Detroit with his wife, and soon adjusted himself to civil life and the pursuit of his scientific labors, which, with his military services, secured him renown.

The President said:

In the summer of 1867, before the advent of transcontinental railroads, Major Powell organized a party of naturalists and students and took them to the mountain regions of Colorado Territory; and the next summer, 1868, he organized a second expedition, for the purpose of pushing further into the canyon country. In the spring of 1869 he organized the famous expedition for exploring the canyons of the Green and Colorado rivers. This undertaking has been happily characterized as of "phenomenal boldness and its successful accomplishment a dramatic triumph." This evening Dr. Charles R. Van Hise will speak of him as an explorer.

POWELL AS AN EXPLORER.

Mr. Van Hise said:

It is an honor to be permitted to take part in this tribute to the memory of one of the great American scientific men. In such a tribute I am especially glad to join, for it was my privilege to know and to love Major Powell.

In the few minutes allotted to me to speak, I can not give an account of his many explorations, and therefore I shall confine myself to his characteristics as an explorer. These characteristics are perhaps best revealed by his explorations of the arid lands of the West, and especially of the Colorado canyons.

The project to follow Green River from the crossing of the Union Pacific to its junction with the Grand, and thence to follow the Colorado River to the lowlands of southern California, with the knowledge that these rivers passed through many dark canyons, thousands of feet in depth, through which no one had before passed, was bold to the last degree. Probably no one so well as Powell appreciated the dangers which he would encounter in this journey. He knew that the Green River, at the point at which he started, was six thousand feet above the sea. He knew that where the Colorado River emerges from the Grand Canyon it is but little above the sea. From the point where he entered to the point where his journey was to close there was a descent of more than a mile, and this, to a certainty, meant numerous rapids and falls. The probability was that the rapids and falls would be in the narrow, steep-walled parts of the canyon. There was the full possibility that when nearing some of the falls the stream would be too swift to stem, that no side portage could be made, and that the expedition would result in death to all.

This risk he took. The risk of possible failure and disaster to his party must be taken by each leader of a difficult and dangerous exploration. But it does not follow that all proposed explorations are justifiable. Upon the leader of an expedition rests the serious responsibility of deciding whether the risk is too great and the plan therefore rash, or, upon the other hand, the chances for success and the importance of the enterprise are sufficient to warrant the attempt. This is the crucial question with every leader of a bold exploration. This is the question whose answer demands that the leader shall have all available information as to the region in which he is to go, as to the manner in which the forces and agents of nature are at work in that region, in a word, to have the fullest appreciation of the dangers and the character of the difficulties which are to be overcome. Not only must he know all the facts obtain-able as to the region to be explored, but he must have the best of judgment in weighing their meaning; uninfluenced by his desire to explore the region, uninfluenced by any consideration except his responsibility upon the one hand as to his men, and his responsibility upon the other hand as to the advancement of knowledge. This capacity for the faithful study of all the facts known about a region, the power to comprehend their possible significance with reference to the success of an expedition, are the qualities which separate the great, successful explorer from the incapable one whose expeditions are doomed in advance to almost certain failure and often to loss of life.

Preparatory to his great journey through the canyons of the Colorado, Powell spent the larger part of two years in careful exploratory work in the plateau country of the West, thus, so far as possible, fully acquainting himself with the problem before attempting its solution. Bold the project was, but Powell with delicately balanced judgment, decided that the chance for success and the chance to escape from the canyon in case of the impossibility of the accomplishment of the project, were sufficiently great to warrant the undertaking.

Powell's full appreciation of the dangers of the exploration was shown by the extreme care with which he made preparations. Boats the strongest possible were built, but not so large that they could not be carried. They were provided with water-tight compartments fore and aft, so that they would not sink when swamped. All the necessary articles, from provisions to instruments, were divided into equal parts and distributed among the boats, so that wrecking one boat would not necessitate the abandonment of the expedition.

In this matter of careful consideration of all the dangers involved, forecasting of difficulties and preparing for each of them, Powell is to be compared with Nansen, who has done two great pieces of successful exploratory work, the first crossing of Greenland and the drifting expedition of the *Fram*. In all three of these expeditions not a man was lost who remained with his leader. It is true that great dangers were encountered. It is true that at various times, whether disaster would come to the members of the expedition seemed to lie almost on the turning of a hair; yet the resourceful strength of each, at the critical moment, turned the balance in the right direction; whereas a weaker and less courageous man, a man with less foresight and less power to quickly decide upon the safe course, would almost certainly have failed. In marked contrast with the explorations of Powell and those of Nansen are many ill-advised expeditions which have resulted in the loss of many or all of its members; and yet, in some cases, a man, simply because he has endured great hardships which proper foresight would have prevented, has been rewarded as a hero, whereas he should have been held responsible for the death of the men who supposed him to have qualities which justify leadership in a difficult enterprise.

I would not be misunderstood upon this point. In some cases where careful preliminary study has been made, where well matured plans have been formed, where good judgment warranted the undertakings, where the leaders had all the qualities of successful explorers, misfortune has befallen the parties. There is legitimate room for accident. No man may feel himself so powerful and resourceful that, at all times, he can overcome the forces of nature. Disaster has sometimes befallen the best. It might well have been that Nansen or Powell should have failed. But in the great preponderance of cases the success or failure of an exceptionally difficult and dangerous expedition is dependent upon a previous, exhaustive study of conditions, upon the foresight shown in careful and complete preparation, upon the capacity to estimate chances, upon the resourcefulness of the leader in times of stress. In all these respects Powell proved himself to be in the first class among explorers.

On May 24, 1869, the party of ten men in four boats starts on its perilous journey. The difficulties to be overcome in the canyons of the Green and the Colorado are found sufficient to try Powell to the utmost. Wherever the rivers traverse the hard rocks there are many rapids and falls to be run or portaged. The boats are frequently swamped and the provisions wetted again and again, so that a large part of them are spoiled. Early in the expedition one of the boats is completely wrecked. Some days later the courage of one of the men fails, and he leaves the party. But the nature of the difficulties and the way to overcome them are gradually learned; and then all goes well until the Grand Canyon is reached. But here the river turns into the granite, a harder rock than had been before encountered. Rapids and falls follow one another in quick succession. At various places it seems all but impossible to run the rapids or portage the falls. But the granite area is finally cleared in safety, and in the sedimentary rocks below rapid progress is made. But again the river turns into the granite; and when a set of bad rapids and falls are approached the spirits of three of the men fail. They have not the sustained courage which rises as difficulties and dangers increase. They decide to climb out of the canyon rather than to continue. They remonstrate with Powell and the remainder of his party, trying to prevent them from continuing a course which seems to them to lead to certain destruction. A second boat is abandoned, and with this boat the barometers and the fossils and minerals collected. The scanty almost spoiled provisions and the maps and notes — records of the expedition — only are retained. Probably but few fully appreciate the desperate frame of mind in which a leader of Powell's scientific instinct must be before he takes such a step as this. With deep misgivings, the two boats and the remainder of the party, six in number, push on. Early in the morning the rapids before them are successfully passed, but greater difficulties are found below. In the afternoon a set of rapids and falls is approached which it seems impossible to portage. There is nothing to do but to attempt to run them, with the certainty that the boats will be swamped, but with the hope that the air-tight compartments will bring them to the surface below the falls. Such a course would seem rash to the border of madness, had not previous experiences shown that it was possible. Both boats run over the falls, and are swamped as expected, but the men cling to them and emerge in safety in the pool below. The very next day they run out of the granite, and out of the Grand Canyon. The expedition has achieved success.

Many explorations are undertaken for the love of adventure or personal glory, with the desire that it shall be known that the explorer has reached a place in advance of any other civilized man. Indeed in the past there has been no easier way to gain the notice of the public than by some such piece of exploration. But for this Powell cared little. The primary purpose of his explorations was not to get into unknown territory for its own sake, was not even to become a pathfinder (the purpose of many explorations), but was to study the region through which he went, in all its aspects.

This is illustrated by the rare allusions to himself in the accounts of his explorations. Powell having lost an arm at Shiloh, was only one-handed when he made his famous journey down the canyons of the Green and Colorado. Only those who have climbed difficult cliffs and mountains will appreciate this tremendous handicap for his proposed work. How easy it would have been, in Powell's narrative of the expedition, to have often alluded to this fact, to have intimated the exceptional courage required because of it, to have mentioned in speaking of scaling the walls of the canyons as he often did, in order to study the topography and geography of the region, that this climb was made exceedingly difficult and dangerous because of his lack of a hand. But one may read his narrative from one end to the other, and, did he not know before the fact that Powell was a one-armed man, this would not be discovered.

We all know the physical energy required for exploration in a new region. Those who have been in the arid region of the West fully appreciate the discomforts which must be endured. These are the points which are commonly dwelt upon by the ordinary explorer. But in Powell's accounts of his explorations there is but little said about the hardships which he endured, and but the briefest descriptions of the difficulties which were overcome, the dangers which were encountered.

The purpose of Powell's explorations was to learn of the regions through which he traveled. Many explorers have the same purpose, but in most cases, because of their limitations, their valuable observations are confined to one line of inquiry, as the geography, the geology, the plants, the animals, or the men; but, like Darwin, Powell was interested in all, and not only in these subjects, but in the possible future service to the nation of the lands which he explored.

Nor, in his observations, was Powell satisfied with descriptive notes. While the facts which he saw were interesting to him, they were chiefly so in that, combined with other facts, they might cause him to see deeper into the laws of nature. He not only described the geographic facts of the region through which he traveled, but he gave many of the basal ideas upon which the science of modern physiography is built. Indeed, the most fundamental of them all, the conception of base-level, is his contribution. It was not sufficient for him to describe the mountains of the Park Ranges, of the Uintas, of the Great Basin; he must know about their origin and give a genetic classification of them. He became deeply interested in the Indians and their institutions. He saw that a knowledge of their customs was essential to an understanding of the more complex social life of civilized communities, and out of his keen interest has grown the Bureau of American Ethnology. Thus Powell's irresistible tendency to philosophize — to see the inner meanings of things — runs through all his narrative. He was not content merely to see the phenomena about him; he must interpret them in the terms of the forces and agents which produced them.

Also in Powell's accounts of his explorations one catches the exalted moods of the poet. He keenly appreciated the wonders and beauties of the region through which he traveled, and his descriptions often become prose poetry.

Finally, Powell gave the benefit of his knowledge of the arid region to the legislators of the nation. He saw that the arid lands, occupying nearly four tenths of the area of the United States, were a possible great resource to the country, but an exceptional resource, which could not be wisely handled under common law. He saw that here there was no danger of monopoly of the land, but that the real danger was the monopoly of water; that he who controlled the water was master of the land. Consequently he proposed broad and statesmanlike legislation for the division of the lands of the West which are not mining lands into wheat lands, pasture lands, and irrigable lands, and proposed that they should be controlled by special laws. To a large measure the suggestions which he made have been incorporated into statutes. At the present time it has been recognized that these three classes of lands must be handled differently, each having special legislation applicable to it.

In conclusion, it is clear that Powell, the explorer, was an explorer with a broader and higher motive than that which controls many. His purpose was not to perform a difficult feat, and thereby gain personal glory. His purpose was not even to find a path. His purpose was to make observations through the whole realm of objective knowledge and to advance the philosophy of science. His purpose was to find the way by which the region explored would be of best service to the nation. Through the gauzy mask of the great explorer we see standing out in clear and dominating relief the comprehensive and philosophic scientist, the poet, and the statesman.

The President said:

The explorations developed into an organized survey, embracing the geography, geology, ethnology, and natural history of the country, known as the Geographical and Geological Survey of the Rocky Mountain Region, which existed until 1879, when it and the Hayden and Wheeler surveys were discontinued and the present United States Geological Survey was created. Major Powell was the leading advocate of consolidation. True to his genius for organization, he perceived clearly that the scattered forces should be conjoined and correlated. With his hearty support Mr. King was made the first Director of the new Survey; and when, after a brief incumbency, Mr. King retired, Major Powell was immediately made his successor. This occurred in the spring of 1881. The Geological Survey was well established under Mr. King, and during the thirteen years of Major Powell's directorate its growth, in functions and correlative parts, was remarkable. Mr. G. K. Gilbert, long an associate with Major Powell in geological work, will speak of him as a geologist.

POWELL AS A GEOLOGIST.

Mr. Gilbert said:

In this city of Washington, which was the home of Major Powell, and in the national Geological Survey, whose labors he guided for so many years, it is not easy to reach an impartial estimate of his contribution to geology. The glow of his enthusiasm, the illumination of his broad philosophy, the warmth of his friendship, are still with us, and we should be either more or less than human to divest ourselves so soon of the influence of his inspiring personality.

It was through this personality, too, that he accomplished much of his work for science. Gathering about him the ablest men he could secure, he was yet always the intellectual leader, and few of his colleagues could withstand the influence of his master mind. Phenomenally fertile in ideas, he was absolutely free in their communication, with the result that many of his suggestions — a number which never can be known — were unconsciously appropriated by his associates and incorporated in their published results. I have elsewhere expressed the opinion that the scientific product which he directly and indirectly inspired may equal or even exceed that which stands in his own name.

Geology is indebted to him also for important services in organization and administration. In an epoch of transition, while reconnaissance of our western territories was being transformed into systematic survey, there developed three organizations with similar and equally comprehensive ambitions. Their actual work overlapped; rivalries and animosities arose; and the discontinuance of Congressional appropriations was seriously threatened. Powell, being at the head of one of the surveys, strove first to reach an adjustment by mutual agreement, and failing in that, boldly advocated a complete reorganization. At his suggestion Congress called on the National Academy of Sciences for advice, and the Academy appointed a committee to make a study of the subject. The committee gave careful consideration, listened to all interested parties and to all who had counsel to offer, and eventually reported a plan which had been formulated and advocated by Powell. That plan involved the abolition of the rival organizations, and the creation of separate bureaus for the topographic, geologic, and ethnologic survey of the western part of the United States. It was finally adopted by Congress, except that no provision was made for an independent topographic corps.

The first director of the new Geological Survey was Clarence King, the second Major Powell; and Powell remained in charge from 1881 until 1894, resigning at last when impaired health demanded the husbanding of his energies. This period was one of rapid development of geologic work in the United States, and the administration of the national work was at least an important factor in that development. The field of the national survey was early enlarged so as to include the whole country, and fears were entertained lest a diminution of state work should result; but the state work expanded along with the national, and through measures of cooperation, each strengthened the other. Though official publication was varied and voluminous, it did not fully keep pace with the growth of geologic activity, and the surplus output was so large as to warrant the institution of two geologic journals and an annual volume of geologic transactions.

Turning now to the narrower field of Powell's personal accomplishment in geology, I find that it can be more conveniently epitomized if I first recall to your attention the logical subdivision of all scientific work.

Those who labor for science do three things: They observe the facts of Nature, taking pains to observe them accurately; they arrange the observed facts in groups, or classify them; and they discover their relations of cause and effect, or explain them. When the stage of explanation has been reached a new grouping is made, in which the dominant idea is to bring together things which have a common cause. Some workers devote themselves wholly to observation, using the groupsing and explanations that others have furnished. These are many, and their labors are of great importance. Some there are who strive only to explain, without close observation. These are not in touch with Nature, and their explanations for the most part are of that fallacious order which we call speculation. True explanations are discovered, as a rule, by master workmen who have trained themselves by long apprenticeship in the fundamental work of observation.

The motive which actuates men of science in all this work is the increase of knowledge, but the results of their labor go far beyond increase of knowledge, for they include also increase of welfare. There is a large group of men, not necessarily nor usually students of pure science, whose special function it is to discover ways of applying scientific knowledge to the benefit of mankind. Collectively we call the labors and achievements of these men *applied science*.

Powell's work in geology included observation, classification, explanation, and application to welfare.

His work as an observer began in early manhood, while he was a teacher and afterward a college professor. It ranged through various departments of zoölogy and botany as well as geology and paleontology, and was carried on in the Mississippi Valley, on the Great Plains, and in the Rocky Mountains. It gave him a wide familiarity with the phenomena of Nature, and was of great educational value, but it made no printed record. Afterward he made systematic surveys of the geology of two western districts, one traversed by the Green River and the other by the Colorado, and the results of these surveys were committed to writing and given to the public.

In the second division of geologic work his chief contributions are three in number: A classification of mountains, a classification of processes of land sculpture, and a classification of stream valleys. While these classifications were not founded on principles of causation, and can not therefore be assumed to be final, it is proper to say that each one was characterized by originality, marking a distinct advance on previous classifications; each one has had a distinct influence on the trend of geologic thought; and the elements of each, after nearly three decades of phenomenal development of science, are to be found in all modern text books of geology.

His contributions to explanatory geology pertain likewise to mountains, land sculpture, and stream valleys. He advanced a general hypothesis as to the cause of those local upliftings of the earth's crust which make continents and mountains. He announced the fundamental principles of control in the sculpture of the land, crystallizing his central idea in the new term *base-level*. He introduced a group of explanations of the relations of waterways to mountains and ridges, accompanying the new ideas with three new terms — *consequent valleys*, *antecedent valleys*, and *superimposed valleys*.

None of these contributions to geologic philosophy was elaborated or adequately illustrated; his presentation gave no suggestion of the breadth of the inductions on which they were founded. It was his belief that a scientific fact needed no argument, but only statement. The fruits of his study were cast forth as simple seeds, to germinate or perish, according to their worthiness or unworthiness, or as the accident of their environment might determine. The theory of mountain growth, the last of the group to be announced, rests as he left it, and has not yet demonstrated its vitality by growth. But the ideas embodied in *base-level*, *consequent*, *antecedent*, and *superimposed* fell on fertile ground, and have had a marvelous development. A half score of younger men have elaborated, extended, and applied them; and they stand today for a division of the science so important that it is sometimes called the 'new geology.' Geologists and geographers now recognize that each hill, hollow, and plain of the earth's surface originated by some process of change, and is therefore susceptible of explanation and interpretation. Whereas geologic history was formerly read in the rocks alone, it is now read not only in the rocks but in the forms of the land and the arrangement of the streams.

Powell's contribution to applied geology involved much more than the utilization of geologic knowledge. He dealt with the complex problem of the subjugation to human use of the arid portion of our national domain, and he brought to bear on it the scientific data of climatology and sociology as well as geology. His Lands of the Arid Region, published nearly twenty four years ago, set forth with marvelous insight the conditions by which the problem is surrounded, and formulated the principles by which much of the later work has been guided. It was discredited at the time, because it announced that only a small percent of the far West can ever be reclaimed for agriculture. It raised a storm of indignation because it characterized as semi-arid the middle belt of the plains, toward which settlement was then tending. But today it is recognized as the classic treatise on the subject, the great initial discussion which marked out the lines for future investigation and indicated the evils to be remedied by future legislation. It began a great agitation, in which Powell took a leading part for many years. At his suggestion Congress appointed a commission to study the physical and economic conditions of the arid region, with a view to the modification or reconstruction of its land laws; and he gave two years to the work of this commission. Afterward, as Director of the Geological Survey, he was charged with the measurement of the streams, the survey of reservoir sites, and other researches looking to the conservation of the water supply for the broadest development of irrigation in the region of meagre rainfall. And his interest continued unabated after his retirement from the directorship had relieved him of responsibility. The economic problems were complicated by conflicting interests; the effort for reform was a disheartening struggle, with many failures and reverses; and the end is not yet; but it is a matter of congratulation, as well as of poetic justice, that during his last sickness Powell was able to know of the passage of the Reclamation Act, the most important triumph of the arid lands agitation.

As a successful student of the structure of the Uinta Mountains and Colorado Plateaus, Powell holds an honorable position in the large and honorable company of geologic surveyors. As a frontiersman in a new territory of geologic thought, he takes high rank among the leaders of the science — albeit of a science in which he labored for but half his active life. As an oganizer, as a promoter of research by others, as an educator of men already highly trained, he has made all who profit by good geologic work his debtors. As an original, far seeing, and patriotic advocate of an enlightened policy for the reclamation and highest utilization of our arid domain, he is entitled to the gratitude of the Nation.

The President said:

To the administration of the rapidly expanding Geological Survey was conjoined that of the Bureau of Ethnology. If this was a smaller and weaker child, it ever received his tenderest care and was probably his greatest delight. One might not inappropriately say that it cheered his declining years and received his last blessing. Starting in early years with the study of inanimate nature and the lower forms of life, it was almost inevitable that this broad and profound investigator should pass on to the study of man himself and all his activities. It is probably in the nature of things that this subject should not appeal strongly to a young and vigorous nation, bent on realizing by the shortest cut its own high destiny, and the fact that this bureau prospered for twenty three years under the administration of Major Powell, its founder, is eloquent testimony to his genius for directorship and guidance.

Mr. W J McGee, his associate and administrative support in his later years, will give to us his estimate of Major Powell as an anthropologist.

POWELL AS AN ANTHROPOLOGIST.

Mr. McGee said:

As a citizen of the Republic, Powell was a patriot; as a soldier, he was a hero; as an explorer, he was a leader of brave men; as a geologist, he was a master among the builders of the science; but it was as an anthropologist that he came to his best — for he was, more than any other, the maker of the broad Science of Man.

As a student of human kind, John Wesley Powell ranks among the leading figures of history; his place can be defined only in terms of great men and the greater epochs in the growth of human knowledge.

In the first epoch of that consciously organized knowledge now called Science, men slowly summed their experiences of the fixed features of sky and then of earth, and thus shaped those sciences still called exact because they deal so largely with the constants of Nature; then knowledge advanced by centuries of uniform experiences, and the more variable factors of Nature were not systemized. Such was the epoch culminating in the glories of Alexandria and Athens, when adult Art led infantile Science upon the stage of human activity. The natural sciences were not; and although the philosophers taught "Know thyself," much as Pope long after proclaimed:

> The proper study of mankind is Man,

and although Praxiteles and Phidias attained a knowledge of external anatomy hardly less refined than that of today, the prevailing notions concerning races and peoples, as well as of physiology and pathology, were fantastic and myth tinged. Yet the epoch yielded systems of philosophy, summing the ever multiplying experiences of the relations between the human mind and external Nature, which have fertilized knowledge throughout all the later centuries. Powell was among those who drank deep at the perennial fount of classic philosophy; and the course of his intellectual career was laid with constant reference to the courses followed by the pioneers of definite thought about the eastern shores of the Mediterranean.

In the second epoch of science, men summed the experiences of generations rather than of centuries, and of the variables as well as the constants of Nature; and so the natural sciences came up, chiefly in northwestern Europe. Eminent among the pioneers of this renaissance was Linné, who framed a "System of Nature" still regarded as the foundation of the modern sciences of organisms; and here the genus *Homo* was first defined in terms acceptable to modern students. Later in the same epoch Huxley indicated "Man's Place in Nature" and Darwin traced the "Descent of Man" in terms at first evoking dissent from many, yet in such masterly fashion as to affect all later thought and leave a permanent impress on science. Other contributors there were in numbers; but these three — Linné, Huxley, and Darwin — stand out not merely as leaders of thought but as expositors of the structural similarities between the genus *Homo* and other genera of the animal realm. Another pioneer of the Renaissance — *the* pioneer in some respects — pushed out along in a course midway between that of classic philosophers and that of the rising naturalists; this was Francis

Bacon. In framing his "Novum Organum" this unexcelled genius clearly saw, and affirmed, what the earlier philosophers had only half perceived, *i. e.*, that Mind is a mirror of Nature, and hence that what men call knowledge is but a more or less imperfect reflection of external Nature. All of these great thinkers, like the leaders of the earlier epoch, helped to shape the life of Powell; he began his intellectual career as a Linnean; then, like other naturalists of his time, he became a Darwinian; and during his later years he became, perhaps more fully than any other of his generation, a Baconian.

The first epoch in the growth of definite knowledge was that of the physical, or exact, sciences; the second was that of the natural sciences; and these were followed by a third — in some respects an echo of the second — in which the human sciences took shape. During this epoch the experiences of decades were summed, rather than those of generations or centuries as in earlier times; and the experiences were especially those of the variables of Nature found in human conduct. The students were of the explorers and pioneer settlers pushing out over new lands inhabited by alien peoples, especially the continents of the western hemisphere. These soon learned from stress of contact that the really essential characters of alien races are not those of structure or stature or skin color, but those of habitual conduct; and as the quickened experiences pressed, the more thoughtful of the pioneers were led to classify the aborigines by their actions and dispositions, with little regard for their physical characters. This was the germ of a rejuvenated ethnology, *i. e.*, a science of races based on human rather than animal attributes; and it was an easy step thence to the definition of tribes by their special habits of thought and the speech in which these were expressed. Although this third epoch in the history of science began a generation or two before Powell, he arose in time to give it character; he became the chief prophet of the doctrine of the differences between human and other animals, just as Linné and Huxley and Darwin were the leading apostles of the similarities of all animate Nature; he stood almost alone in seeking to raise the humanities — or the human activities, to use his own term — to the plane of scientific research; and while he gave less thought than some deemed needful to the physical characters of man, he strove unceasingly to harmonize the New Ethnology with the philosophies of the earlier epochs, and thereby to erect a comprehensive anthropology broad enough to touch every human ideal and passion and law and motive, as well as the physical structures of the human body and brain. The Anthropology of today is the science of the realm of self conscious activity; and Powell was its chief creator.

In defining Powell's career as an anthropologist, it is to be remembered that he began a naturalist and developed as a geologist, so that he brought to the study of men a rich store of knowledge of Nature as well as a strong grasp of the scientific method. Especially notable among his possessions was a principle brought over from geology — the principle of interpreting natural phenomena in terms of agency, or primary force, primary so far, at least, as current knowledge goes. This principle was perhaps the key note of Powell's work in geology; certainly it became the key note of his researches in ethnology and general anthropology.

Now the third epoch in science, or that of the New Ethnology to which Powell gave character, opened slowly, and, curiously enough, largely through the efforts of statesmen rather than of scientists. The actual pioneer of the new era was, indeed, inspired by the practical problems of statecraft; this was Albert Gallatin, who classified the American tribes known early in the last century by their languages, grouped them in linguistic families or stocks, and indicated their distribution on a map, the forerunner of Powell's map of Indian linguistic families of North America north of Mexico. It is somewhat singular that prevailing opinion, even in scientific circles, should credit Powell with originating that work in Indian linguistics in which he was a follower rather than a leader; and this despite the fact that he constantly gave due credit to the eminent statesmen in both public and private utterances. The next notable pioneer of the new epoch was Lewis H. Morgan, who sought to classify the American tribes on the basis of their law as expressed in terms of relationship. This masterly work, published in a noble volume by the Smithsonian Institution, forms one of the earliest and most trustworthy foundations for the science of sociology. The next great contribution to the New Ethnology was a joint product, the chief contributors being Brinton in this country and Tylor in England; they sought a basis for defining and classifying the peoples of the world in their myths and beliefs. Meantime the handiwork of prehistoric and other primitive folk was made known through numerous investigators; while physical anthropology was well advanced, especially in Europe. Such, in brief, was the state of the science before Powell — though it is not to be forgotten that his career overlapped those of Morgan and Brinton, as well as that of Tylor, the sole survivor of the series of pioneers.

In his earlier explorations Powell concerned himself first with the handiwork of the natives, and afterward with their myths; and almost from the beginning his vigorous mind grasped the great fact that both kinds of products, just like those of the processes of geology, are best interpreted in terms of agency, the agency in this case being human thought. Thence his studies extended to the social organization of the tribes — to the law of kinship, to loves and hates, to mating and family life — and then to esthetic concepts, and on to the elaborate observances of ceremonial life; and he mastered the languages, first as a means of gathering facts and later for their own inherent interest. Throughout he found the same fundamental principle to apply, each new observation only confirming the truth that human actions are best interpreted in terms of mental power. An early outcome of the work was a definition of the human activities as a basis for scientific research; and here Powell was able to combine, and thus to raise to higher planes, the admirable work of the pioneers already gone before, as well as that of his contemporaries. Then Gallatin's philology, Morgan's sociology, and the mythology (or sophiology) of Tylor and Brinton fell into orderly relation; while from his new height Powell was able to outline the fields of technology and esthetology, and thus to define the entire domain of the actual humanities.

As his studies progressed, Powell saw that primitive and more advanced men do not think alike — that their minds respond differently to similar stimuli; and he soon perceived that the thought of the lowly man of woodland or water side is more dependent on surroundings than is that of the vigorous scion of a race trained to conquest over nature through many generations. Thus he came to realize that relation between mind and environment which led to his most comprehensive and important generalization, *i. e.*, that of the great stages of human progress. These stages may be defined in various ways; by progress in social organization or law, by progress in industries, by progress in language, by progress in the arts, or by progress in philosophies; yet in the last analysis they express grades of intelligence, and hence correspond closely howsoever defined. As originally outlined the stages are (1) savagery, in which the social unit is the clan, and the organization is based on kinship traced on the maternal line; (2) barbarism, in which the units are the gens and tribe, while the organization is based on kinship traced in the paternal line; and (3) civilization, in which the unit is first the city and later the nation, and in which the organization is territorial — to which may be added (4) enlightenment, in which the units are the individual and the state, while the law rests on equality of individual rights. Mankind may be classified in terms of these developmental stages no less definitely than by skin color and other physical attributes; and there is every promise that the classification of the world's peoples by culture grade will become increasingly important as inter-racial contacts multiply. It was in these broader generalizations that Powell especially profited by the genius of such great predecessors of the earlier epochs as Aristotle and Bacon.

When a knowledge maker has given form and substance to a great science; when he has shaped an epoch in the development of human knowledge; when by the vigor and extent of his work he has raised himself to the first place among the scientists of his generation; and when, withal, he has constantly fostered every scientific activity of his land, and has performed public administrative duties in science of unequaled magnitude, his work is not easily summarized within the space of a few minutes. The published details of Powell's work fill volumes; yet in ethnology and general anthropology, no less than in geology, the larger share of the fruit of his vigorous thinking was turned over freely to colaborers, with a generosity unparalled in the history of science, to find its way into the general body of human knowledge under other names than his own.

So brief an outline as this admits no more than the baldest mention of Powell's greatest contributions to the Science of Man: the recognition of agency in the human realm; the identification of that agency with the progressively growing mentality of the generations of men; the definition of the human activities as the basis of sciences of a new order; the recognition of the culture stages as way marks of progress in the past and as guides for further advancement; and, toward the end of his labors, the recognition of Mind itself as the sublimest product of natural interactions — these are among Powell's greatest gifts to the world. And it may not be forgotten that while these and other contributions grew out of patient research by the rigorous methods of science, they were warmed by a personal humanity of unsurpassed richness and sweetness — for Powell loved mankind with all the ardor of a great heart.

As Major Powell's most intimate scientific friend for years, it may be permitted me, nay, it behooves me, to say a word of his uncompleted work as well as of his duties done. As many know, it was the ambition of his life to build up a great Bureau of the Science of Man no less beneficent than the Bureau of the Science of the Earth which he did so much to create — to establish a Bureau of Ethnology no less firmly and broadly than the Geological Survey was established; but here fortune failed him in ways it were premature to define — and, despite the cheerful face of life-long habit, this failure gradually broke the Old Man's sturdy spirit, embittered his later years, and undoubtedly shortened his life.

Another ambition long glowed brightly in the Major's mind; it was that of summing all knowledge and philosophies, from those of savage and lower barbarian up to Plato and Aristotle, thence to Bacon and Linné, and on to the third epoch of science to which he was so rich a contributor, in an organon or system, of three parts. The first of these was to deal with Nature, *i. e.*, the external universe; the second with Man, the highest product of Nature; and the third with Mind, the ultimate natural power of Nature and Man. The work was directed toward general human understanding rather than conventional forms and current lines of thought, and was cast in the form of a trilogy, with an explement in poetic form and measure; and with a view to general and hence permanent character, both structure and form were modeled after artistic rather than technical standards. In giving shape to the triune work the Major delved deeply in lore and literature of every type, sifted through the meshes of his own broad knowledge the golden product of science in every branch, studied the mental workings of contemporaries and even of associates as he had studied those of savages before, and sought to sum the whole under simple allegorical titles. The breadth of the plan and the depth of its foundations were little realized by coworkers, still less by critics of the preliminary essays; indeed, the modesty of the author seldom permitted him to see in its full magnitude the mighty task to which he was impelled by the same powerful instinct that inspired his military and exploratory efforts — the task of framing a cosmic compendium at once broader and simpler than any previously conceived. Of this work the first part was written in preliminary, and far from satisfactory, form, and was published under the title "Truth and Error"; much of the second part was tentatively incorporated in a series of papers in the *American Anthropologist* designed for reprinting, with extensions, under the title "Good and Evil"; while of the third part, designed to bear the title "Pleasure and Pain," only an outline, with notes, and a single preliminary chapter were completed. The poetic argument, or explement, though designed to round out the whole and perhaps to form a final volume, was in reality the first written and the most complete portion of the work, for it ran through the author's mind as a golden clew if not a more definite outline, and was put in finished form before the Major left the Geological Survey to undergo the third operation on his arm; two or three copies of the manuscript are extant (including one in the cornerstone of the Gardiner Greene Hubbard memorial building). The Major long had a plan for the completion of his organon in case he was cut off before it was done; but, with characteristic optimism he failed to secure effective approval of the plan in writing, so that it may never be carried out.

Still John Wesley Powell is not without monuments: The Ethnological Bureau which he created, and which he conducted for twenty three years under difficulties and against obstacles which will never be known, has long been regarded as a model by the ethnologists of every land; the four or five series of ethnologic publications under his name form a library of the science on which the anthropologists of the world are constantly dependent; his minor papers and addresses have done no less than the greater tomes to establish the Science of Man; yet his noblest monument, and the one which he would most appreciate, is that loving memory that lives in the hearts of his fellows in the study of Humanity.

The President said:

In passing in review the organizations of which Major Powell was one of the founders, directors, trustees, or active supporters, one or all, we cannot fail to take notice of the Philosophical Society of Washington, the Anthropological Society of Washington, the National Academy of Sciences, the American Association for the Advancement of Science, the National Geographic Society, the Columbian University, and the Cosmos Club. These, and doubtless others which do not come to mind at the moment, owe much to the fostering care and wise guidance of this admirably poised man, who, while sturdily self-reliant, did not lose sight of the power of combined and well-directed forces.

Major Powell, in establishing and administering organizations, founded firmly and developed broadly. From nature he had learned that nothing worth while is ever accomplished suddenly or done in a hurry, and he knew that his own work must be carried forward by others after he was gone if it was to be of permanent value. He was therefore patient and thorough in his own personal work, and selected his assistants and collaborators with care. To them he left details and particulars of ways and means: he asked only for results in due time. But he was ever ready and glad to consult with and advise them in regard to their work— to sympathize with and help them in their discouragements and to rejoice with them in their successes, and when he severed his official connection with the Geological Survey tears were shed by more than one. His farewell to his collaborators, which may be found in the Fifteenth Annual Report of the Geological Survey, is rare reading. It is a page of pathos. Major Powell's personality was known only to those near and dear to him. None can speak of it more fittingly than his friend, Dr. S. P. Langley.

POWELL AS A MAN.

Mr. Langley said:

We have heard tonight about the different aspects of the life of our friend, Major Powell, as a soldier and as a man of science; and, I am told, that as his friend, something is desired from me about the man himself.

He has just been described by eminently competent judges in nearly all the varied elements of his character and career. His personality inspired the interest of men so distinguished as those who have just addressed you, and if the parts of that personality of which they have spoken, make the man, what remains to be said which can add to what you have already heard?

If there be anything outside the soldier, the explorer, or the man of science, it lay in a singularly simple and strong humanity; a something which took hold of you and made you his friend. While he was here he filled an almost unique place in one's life, and now that he has gone, there remains a gap which no other can fill. Will you indulge me, then, if I speak a few words of Major Powell, exclusively as I knew him in the guise of a friend?

I have been with him in the life of the city and in the life of the wilderness; I have sat with him at distinguished boards, and I have ridden alone with him through the wilds that are still half unexplored in the domain of our Great West; but wherever I have been with him, in whatever surroundings, I think I have been more impressed with the simplicity and self comprised nature of his character than even with the complexity of his knowledge and achievement. He was to me not so much one of the common figures of daily life, as one of Plutarch's men; and while it has been my pleasure to know such a nature as his under its more unfamiliar aspects, I could wish that I were better able to describe clearly what I so clearly feel.

My acquaintance with Major Powell began soon after his return from his wonderful exploration of the Grand Canyon of the Colorado; but my first intimate knowledge of him dates from the time when, on the platform on which I now stand, he delivered an eulogy on his own familiar friend Professor Baird, my honored predecessor in the Smithsonian. It had been my lot to convey to him the first news of this friend's death, and it was in that hour, when I saw him touched to tears, that I first discovered that phase of his character which has ever since been evident to me, that side which was open to the approach of affection, and which could express itself in language which came from the heart to the heart.

There is always in speaking of a very near friend a sense of perhaps lifting a veil that should be allowed to cover the inner life from the intrusive gaze of the world; but what I may say is already known to those near to him.

Besides his splendid capacity for leadership in battle, and his readiness for the strenuous life of adventure in which he was almost the last great explorer in the field of which we have been told; besides his varied knowledge as a scientific man; there was something which colored and leavened the whole: and that was an imagination akin to that of the poet. This never expressed itself publicly, but always formed a large part of his inner being. The mystery of this world, which pure science so little recognizes, was always present to one side of Major Powell's mind, if indeed, it was not present to all. A part of his writings known only to his friends, contained visions of the poetical aspects of Science, and especially of the poetry of geology and paleontology. The long lapse of ages, the wonderful birth of species, the path that threaded the æons of time, on and up to man; — all these things were present to his thought, and colored his work. With it there was a sympathetic interest in those mental problems which are relegated to metaphysics; but these questions were always before him and were made the subject of eager investigation, so that in contemplating the whole man we must remember that these, although they were not announced to the world, formed an essential part of his thought, and were always associated with what he did as a man of science, and constituted, indeed, his innermost point of view.

The veil of which I speak should rest on the subject of his family affections, for even here, as elsewhere, he was self contained, and he needed not to speak of those things even to a friend as near as I was privileged to be.

Going outside of the realm of these affections into that of his relation to the world, we still find Major Powell reticent of expression of opinion. Sincere he was, and truthful to the point of being unable to bring himself to hint the thing which is not, nor even to allow the shadow of deceit in his ways. Such sincerity existing in his own heart, begat a confidence in others, which did not always meet its just return. I do not admit that this sincerity and trustfulness were faults in his character, but if they were, they were faults for which we loved him.

I feel how wholly inadequate these few words are as an eulogy of the man, and I can only plead that the very nearness of my affection for him makes it difficult for me to say dispassionately what such an occasion as this might seem to demand. He was a generous man, kind to others and helpful; a combative and a brave, and always a self contained man, who found in himself counsel sufficient for his need. He was a stoic who suffered long years of pain in silence and who at the end met the approach of death as though it were a familiar incident of life. He was a truthful and steadfast man, and one who never deserted a friend. We shall not often look upon his like.

Proc. Wash. Acad. Sci., July, 1903.

He was my friend, and this at an age when few old friends remain to us. His loss was to me, therefore, one which can never be made good. Among men I have known, he stands within the circle of those whom perhaps I might most hope to see on that silent shore, where according to old belief, dear friends may meet again.

The Committee on Arrangements were:

Mr. Charles D. Walcott, *Chairman*, representing the Washington Academy of Sciences.

Mr. G. K. Gilbert, *Secretary*, representing the National Geographic Society.

Mr. A. Graham Bell, representing the National Geographic Society.

Mr. J. S. Diller, representing the Geological Society of Washington.

Mr. Harrison G. Dyar, representing the Entomological Society of Washington.

Mr. W. F. Hillebrand, representing the Chemical Society of Washington.

Mr. W. H. Holmes, representing the Anthropological Society of Washington.

Mr. John A. Kasson, representing the Columbia Historical Society.

Mr. S. P. Langley, representing the Smithsonian Institution.

Mr. Frederic A. Lucas, representing the Biological Society of Washington.

Mr. Richard Rathbun, representing the Philosophical Society of Washington.

Mr. A. R. Spofford, representing the Columbia Historical Society.

CATALOGUE OF THE PUBLISHED WRITINGS OF JOHN WESLEY POWELL.

Classified in Five Subject Groups, the Papers in Each Group Arranged Chronologically.[1]

By P. C. Warman.

GEOLOGY AND GEOGRAPHY.

1867.

1. [Exploration of the valley of the South Platte, Colorado, and ascent of Pikes Peak.]

In Scientific expedition to the Rocky Mountains: preliminary report of Prof. J. W. Powell to the Illinois State Board of Education, pp. 3–4, Normal, Illinois (Nason, printer, Peoria), dated December 18, 1867, 8°.

The only copy known to the compiler is in the library of the United States Geological Survey, Washington, D. C. It consists of 4 pp., 8°; no title page.

1872.

2. [Length, descent, and other features of the Green and Colorado canyons.]

In 42d Congress, 2d session, House of Representatives, mis. doc. No. 173, Survey of the Colorado River of the West, letter from the Secretary of the Smithsonian Institution, transmitting report preliminary for continuing the survey of the Colorado of the West and its tributaries, by Professor Powell, p. 2, Washington, D. C., 1872, 8°. The pamphlet consists of 12 pp. Powell's report is dated March 25, 1872.

[1] A single series of numbers (1 to 251) has been run through the five groups, for reference purposes. If allowance be made for the cases in which a publication is, in whole or in part, listed and numbered more than once, because it contains two or more classes of matter, it will be found that the number of distinct publications is 209. For remarks on unpublished writings, see pages 124–126.

1873.

3. [Sketch of the geographic and geologic features of the Colorado Canyon and adjacent region.]

In 42d Congress, 3d session, House of Representatives, mis. doc. No. 76, report of the survey of the Colorado of the West, letter from the Secretary of the Smithsonian Institution, transmitting a report [by Professor Powell] of the survey of the Colorado of the West and its tributaries, pp. 4, 8–14, Washington, D. C., 1873, 8°. The pamphlet consists of 16 pp. Professor Powell's report is dated January 17, 1873.

In this report the valleys are classified in two orders, *longitudinal* and *transverse*, and each of these in three varieties.

4. Some remarks on the geological structure of a district of country lying to the north of the Grand Cañon of the Colorado; by J. W. Powell.

In American Journal of Science and Arts for June, 1873, 3d series, vol. 5, pp. 456–465, New Haven, 1873, 8°. Contains the classification of valleys mentioned above.

Issued separately, also, entirely reset; 8 pp., 8°.

1874.

5. [Summary of geographic and geologic data gathered, to date, in the Colorado Canyon and adjacent region.]

In 43d Congress, 1st session, House of Representatives, mis. doc. No. 265, Professor Powell's report on the survey of the Colorado of the West; letter from the Secretary of the Smithsonian Institution, transmitting a report of Professor Powell on the survey of the Colorado River of the West and its tributaries, &c., &c., pp. 2–19, Washington, 1874, 8°. The pamphlet consists of 29 pp., 8°. Professor Powell's report is dated April 30, 1874.

Appeared also in Report of explorations in 1873 of the Colorado of the West and its tributaries, by Professor J. W. Powell, under the direction of the Smithsonian Institution, pp. 4–25, Washington, 1874, 8°. Pamphlet consists of 36 pp.

6. Remarks on the structural geology of the valley of the Colorado of the West.

In Philosophical Society of Washington, Bulletin, vol. 1, pp. 48–51, Washington, 1874, 8°. An abstract.

This Bulletin also forms the first part of Smithsonian Miscellaneous Collections, vol. 20.

1875.

7. The cañons of the Colorado. By Major J. W. Powell.

In Scribner's Monthly, an Illustrated Magazine for the People (conducted by J. G. Holland), for January, February and March, 1875, vol. 9, pp. 293–310, 394–409, 523–537, New York, [1875], 8°.

8. Physical features of the Colorado Valley. By Major J. W. Powell.

In Popular Science Monthly for August and September, 1875, vol. 7, pp. 385–399, 531–542, New York, 1875, 8°.

Introduces the term *base-level* of erosion.

9. An overland trip to the Grand Cañon. By Major J. W. Powell.

In Scribner's Monthly, an Illustrated Magazine for the People (conducted by J. G. Holland), for October, 1875, vol. 10, pp. 659–678, New York, [1875], 8°.

10. The ancient province of Tusayan. By Major J. W. Powell.

In Scribner's Monthly, an Illustrated Magazine for the People (conducted by J. G. Holland), for December, 1875, vol. 11, pp. 193–213, New York, [1876], 8°.

11. Explorations of the Colorado River of the West and its tributaries. Explored in 1869, 1870, 1871, and 1872, under the direction of the Secretary of the Smithsonian Institution.

Washington: Government Printing Office. 1875.

291 pp., 4°, map and profile diagram in pocket.

Part first. History of the explorations of the cañons of the Colorado.—Part second. On the physical features of the valley of the Colorado.—Part third. Zoology (by Coues and Goode).

Classification of valleys, pp. 160, 163; base-level of erosion, p. 203.

For revised and enlarged edition see No. 41.

1876.

12. Department of the Interior. U. S. Geological and Geographical Survey of the Territories. Second division.—

J. W. Powell, geologist in charge. Report on the geology of the eastern portion of the Uinta Mountains and a region of country adjacent thereto. With atlas. By. J. W. Powell.

Washington: Government Printing Office. 1876.

218 pp., 4°.

Types of orographic structure, p. 9; structural geology, p. 173.

13. Types of orographic structure; by Major J. W. Powell.

In American Journal of Science and Arts for December, 1876, 3d series, vol. 12, pp. 414–428, New Haven, 1876, 8°. Describes eleven types; same descriptions in No. 12.

1878.

14. Report on the methods of surveying the public domain, to the Secretary of the Interior, at the request of the National Academy of Sciences. By J. W. Powell, 1878.

Washington: Government Printing Office. 1878.

Cover, title, and pp. 3–16, 8°.

The report is dated November 1, 1878, and treats of: the unification of the work of surveying and mapping the territories; cost of a geographical and geological survey; zoology and botany; ethnology.

1880.

15. [Remarks on the causes of the Glacial period.]

In Philosophical Society of Washington, Bulletin, vol. 2, pp. 44–45, Washington, 1875–1880, 8°. An abstract.

This bulletin also forms a part of Smithsonian Miscellaneous Collections, vol. 20.

16. Monoclinal ridges.

In Philosophical Society of Washington, Bulletin, vol. 2, pp. 74–75, Washington, 1875–1880, 8°. An abstract.

See on pp. 79 and 85 of the same volume for an expression of opinion as to the thickness of the earth's crust.

This Bulletin forms a part of Smithsonian Miscellaneous Collections, vol. 20.

17. Prefatory note [on the Colorado Plateaus]. By the Director of the Survey.

In United States Geographical and Geological Survey of the Rocky Mountain Region: Dutton (C. E.), Report on the geology of the High Plateaus of Utah, pp. vii–xiii, Washington, Government Printing Office, 1880, 4°.

1882.

18. General [geologic] nomenclature.

In United States Geological Survey, Second Annual Report, pp. xlii–xlviii, Washington, 1882, royal 8°.

Included in paper-covered separates of Director's report.

19. Colors for geologic cartography, and conventional characters for diagrams.

In United States Geological Survey, Second Annual Report, pp. xlix–liv, pls. i–vii, Washington, 1882, royal 8°.

Included in paper-covered separates of Director's report.

1883.

20. Informal remarks on moraines and terraces. By J. W. Dawson of Montreal, and J. W. Powell of Washington.

In Science for September 7, 1883, vol. 2, p. 321, Cambridge, Mass., 1883, 4°.

The remarks were made at the Minneapolis meeting of the American Association for the Advancement of Science in August, 1883.

1884.

21. On the state of the interior of the earth.

In Science for April 18, 1884, vol. 3, pp. 480–482, Cambridge, Mass., 1884, 4°.

Written at the time of the appearance of a new edition of Thomson and Tait's "Treatise on Natural Philosophy," and characterizes the lines of inductive reasoning by which geologists arrive at the conclusion that the earth is not a solid.

22. On the fundamental theory of dynamic geology.

In Science for April 25, 1884, vol. 3, pp. 511–513, Cambridge, Mass., 1884, 4°.

1886.

23. [Letter, dated March 26, 1886, to Dr. Persifor Frazer, Philadelphia, secretary, concerning geologic cartography.]

In The work of the International Congress of Geologists, and of its committees, published by the American committee, pp. 106–108, [Berlin?], 1886, 8°.

24. 49th Congress, 2d session. Senate. Mis. doc. No. 22. Letter from the Secretary of the Interior, transmitting report of the Director of the U. S. Geological Survey on the merits of the bill S. 1907 "to facilitate the settlement and develop the resources of the Territory of Alaska, and open an overland and commercial route between the United States, Asiatic Russia, and Japan," and the feasibility of the construction of the railroad proposed.

Pp. 1–10, 8°, two maps.

25. The cause of earthquakes.

In Forum for December, 1886, vol. 2, pp. 370–391, New York, 1887, 8°.

1888.

26. Methods of geologic cartography in use by the United States Geological survey. (Presented, on behalf of the Director of the Survey, Major J. W. Powell, by W. J. McGee, U. S. geologist.)

In Congrès géologique international, compte-rendu de la 3^{me} session, Berlin, 1885, pp. 221–240, Berlin, 1888, large 8°.

Sub-headings are: introduction; the geographic bases; the geologic maps; general considerations; taxonomy and nomenclature; the conventions; general regulations.

Issued separately, with paper cover bearing title.

27. The laws of hydraulic degradation.

In Science for November 16, 1888, vol. 12, pp. 229–233, New York, 1888, 4°.

A paper read before the National Academy of Sciences at its meeting in New Haven, November, 1888.

Appeared also in The Mining Industry and Tradesman for September 30, and (?), 1888, pp. 226–228, 234–236, Denver, Colo., 1888, folio.

28. Communication on the American report of the International Congress of Geologists.

In American Journal of Science for December, 1888, 3d series, vol. 36, pp. 476a–476e, New Haven, Conn., 1888, 8°.

Separates were issued, without change.

1890.

29. Work in petrography [and remarks on the classes and the study of rocks].

In United States Geological Survey, Tenth Annual Report, Part I, pp. 42–52, Washington, 1890, royal 8°.

Included in the paper-covered separates of the Director's report.

30. Conference on map publication.

In United States Geological Survey, Tenth Annual Report, Part I, pp. 56–79, pls. ii–v, Washington, 1890, royal 8°.

Subheadings: the occasion for the conference; the work of the conference; unit of publication; nomenclature; conventional symbols for geologic maps; conventional symbols for geologic sections.

1891.

31. The new lake in the desert. By J. W. Powell.

In Scribner's Magazine for October, 1891, vol. 10, pp. 463–468, New York, 1891, 8°.

An explanation of the cause of the flooding of the Coahuila Basin, Colorado Desert, southern California.

1892.

32. Our recent floods. By J. W. Powell, LL.D., Director of the United States Geological Survey.

In North American Review for August, 1892, vol. 155, pp. 149–159, New York, 1892, 8°.

1893.

33. The geologic map of the United States. By J. W. Powell, Washington, D. C. (Montreal meeting, February, 1893.)

In American Institute of Mining Engineers, Transactions, vol. 21, pp. 877–887, New York, 1893, 8°.

Read by Dr. C. W. Hayes, the author being unable to be present.

34. The mineral exhibits at Chicago. (Special.) [By J. W. Powell.]

In British Trade Journal for November 1, 1893, vol. 31, pp. 520–522, London, 1893, folio.

Reprinted as follows:

The mineral exhibits of the Chicago exposition. (Special.)

In Kuhlow's German Trade Review, and Exporter, issue for Wednesday, November 22, 1893, vol. 18, pp. 4503–4504, Berlin, 1893, folio.

35. General work in [geologic] taxonomy.

In United States Geological Survey, Fourteenth Annual Report, Part I, pp. 65–122, Washington, 1893, royal 8°.

Headings: growth of classification; relations of sedimentary rocks; correlation of sedimentary formations; relations of igneous rocks; summary of work on igneous rocks; relations of the ancient crystalline rocks; summary of work on Algonkian and Archean rocks; relations of Pleistocene deposits; nature and results of the surveys of glacial formations; relations of land forms; résumé.

36. General summary of work in terrestrial physics, 1880–1892.

In United States Geological Survey, Fourteenth Annual Report, Part I, pp. 143–165, Washington, 1893, royal 8°.

Treats of: rigidity; cohesion and chemic action; pyrometry; piezometry; compressibility and thermal expansion; continuity of liquid and solid states; igneous fusion as related to pressure; geysers and hot springs; isogeotherms; high pressure chemistry; sedimentation; heat conduction; electrical activity of ore bodies.

1894–1895.

37. Explanation [of the Geologic Atlas of the United States].

In United States Geological Survey, Geologic Atlas of the United States, folios 1–20, pp. 2–3 of the cover of each folio, 1894–1895.

An explanation of the plan and uses of the atlas.

See, also, No. 42.

1895.

38. Physiographic processes. By J. W. Powell.

In National Geographic Monographs, prepared under the auspices of the National Geographic Society, vol. 1 (No. 1, for March, 1895), pp. 1–32, New York, Cincinnati, Chicago, American Book Company, 1895, royal 8°.

Major headings are: the atmospheric envelope; the aqueous envelope; the rock envelope; interpenetration of the envelopes; vulcanism, diastrophism, and gradation.

Issued also in separate form, with paper cover bearing title, etc.

39. Physiographic features. By J. W. Powell.

In National Geographic Monographs, prepared under the auspices of the National Geographic Society, vol. 1 (No. 2, for April, 1895), pp. 33–64, New York, Cincinnati, Chicago, American Book Company, 1895, royal 8°.

Major headings are: plains and plateaus; mountains; valleys; hills; cliffs; special forms; stream channels and cataracts; fountains; caverns; lakes; marshes; coast forms; islands.

Issued also in separate form, with paper cover bearing title, etc.

40. Physiographic regions of the United States. By J. W. Powell.

In National Geographic Monographs, prepared under the auspices of the National Geographic Society, vol. 1 (No. 3, for May, 1895), pp. 65–100, New York, Cincinnati, Chicago, American Book Company, 1895, royal 8°.

Major headings: drainage slopes; Atlantic Plains; Piedmont Plateaus; Appalachian Ranges; Alleghany Plateaus; New England Plateaus; Lake Plains; Prairie Plains; Gulf Plains; Ozark Mountains; "Great Plains" (Plateaus); Stony Mountains; Park Mountains; Columbia Plateaus; Colorado Plateaus; Basin Ranges; Pacific Mountains.

Issued also in separate form, with paper cover bearing title, etc.

41. Canyons of the Colorado, by J. W. Powell, Ph.D., LL.D., formerly Director of the United States Geological Survey, member of the National Academy of Sciences, etc., etc. With many illustrations.

Meadville, Pa., Flood & Vincent, The Chautauqua Century Press. M DCCC XCV.

Pp. xiv, 15–400. Type page ordinary 8°, but paper page about 11¼ by 8½ inches, giving very wide margins. Profusely illustrated.

A revised and enlarged edition of the work published in 1875. (See No. 11.) Several of the chapters, descriptive of the region and of the people who inhabit it, were written expressly for this edition. It is, therefore, a distinct publication.

42. The Geologic Atlas of the United States.

In United States Geological Survey, Fifteenth Annual Report, pp. 79–90, Washington, 1895, royal 8°.

Plan, method, and progress of publication. See, also, No. 37.

1898.

43. An hypothesis to account for the movement in the crust of the earth.

In Journal of Geology for January–February, 1898, vol. 6, pp. 1–9, Chicago, 1898, 8°. Read at the November meeting of the National Academy of Sciences, Boston, 1897.

Issued also in the form of separates; no cover.

IRRIGATION AND PUBLIC LANDS.

1874.

44. Report concerning claims of settlers in the Mo-a-pa Valley, (S. E. Nevada,) by Special Commissioners J. W. Powell and G. W. Ingalls.

In Report of Special Commissioners J. W. Powell and G. W. Ingalls on the condition of the Ute Indians of Utah [etc.], pp. 31–36, Washington, 1874, 8°. The pamphlet consists of cover (bearing half-title), title-page, and 36 pp.

1878.

45. [Results of classification of lands in northern Utah, by Mr. Gilbert, and data relating to Great Salt Lake.]

In American Journal of Science and Arts for May, 1878, 3d series, vol. 15, pp. 347–351, New Haven, 1878, 8°.

1878–1879.

46. 45th Congress, 2d session. House of Representatives. Ex. doc. No. 73. Report on the lands of the arid region of the United States, with a more detailed account of the lands of Utah. With maps. By J. W. Powell. April 3, 1878.—Referred to the committee on appropriations and ordered to be printed.

Washington: Government Printing Office. 1878.

195 pp., 4°, 3 maps.

The chapter headings are as follows:

I. Physical characteristics of the arid region.

II. The land system needed for the arid region.

III. The rainfall of the western portion of the United States.

IV. Water supply. (By G. K. Gilbert.)

V. Certain important questions relating to irrigable lands.

VI. The lands of Utah.

VII. Irrigable lands of the Salt Lake drainage system. (By G. K. Gilbert.)

VIII. Irrigable lands of the valley of the Sevier River. (By C. E. Dutton.)

IX. Irrigable lands of that portion of Utah drained by the Colorado River and its tributaries. (By A. H. Thompson.)

X. Land grants in aid of internal improvements. (By Willis Drummond, Jr.)

Second edition as follows:

Report on the lands of the arid region of the United States, with a more detailed account of the lands of Utah. With maps. By J. W. Powell. Second edition.

Washington: Government Printing Office. 1879.

195 pp., 4°, 3 maps.

1888.

47. [Report (dated March 13, 1888) to the Secretary of the Interior concerning the desirability of authorizing the Geological Survey "to segregate lands of the public domain capable of irrigation in the sections of the United States where irrigation is required, from other lands, and to lay out suitable places to be reserved for reservoirs, and rights of way for ditches and canals, for the purposes of irrigation."]

In Senate ex. doc. No. 134, 50th Congress, 1st session, letter from the Secretary of the Interior, transmitting, in response to Senate resolution of Feb. 13, 1888, report concerning the irrigation of certain lands, pp. 3–6, Washington, Government Printing Office, 1888, 8°.

48. [Statement of the general irrigation problem in western United States, especially the location and construction of reservoirs and other works.]

In Senate ex. doc. No. 163, 50th Congress, 1st session, letter from the Secretary of the Interior, transmitting, in response to Senate resolution of March 27, 1888, report relative to reservoirs for the storage of water in the arid regions of the United States, pp. 2–6, Washington, 1888, 8°.

The pamphlet consists of 6 pp., 8°.

1889.

49. [Information relating to the irrigation problem in western United States, and to the progress of the work.]

In Senate ex. doc. No. 43, 50th Congress, 2d session, letter from the Secretary of the Interior, transmitting, in pursuance of law, report of the Geological Survey on the subject of irrigation, pp. 2–12, Washington, 1889, 8°.

The pamphlet consists of 12 pp., 8°.

Reprinted in No. 56, pp. 16–29.

50. [Preliminary report (dated February 8, 1889) to the Secretary of the Interior concerning "the extent to which the diversion of the waters of the Platte and Arkansas rivers and their tributaries in Colorado for irrigation and other purposes affects the flow of the waters of those streams in the lower valleys, and especially during the growing season, and whether the title conveyed by the Government to lands fronting on said streams covers the privilege of diverting water therefrom beyond that necessary for use thereon for irrigation and mining purposes, and what action is needed to protect the rights of riparian owners along the waters of said streams in the States of Kansas and Arkansas, and what measures can be devised to increase the flow of water in those streams during such season."]

In Senate ex. doc. No. 120, 50th Congress, 2d session, letter from the Secretary of the Interior, transmitting, in response to Senate resolution of August 29, [report on] the effect upon certain rivers in Colorado of the diversion of water for irrigation, pp. 2–6, Washington, Government Printing Office, 1889, 8°.

51. The lesson of Conemaugh. By Major J. W. Powell, Director of the United States Geological Survey.

In North American Review for August, 1889, vol. 149, pp. 150–156, New York, 1889, 8°.

1890.

52. Statement of Maj. J. W. Powell, Director of the Geological Survey [in relation to irrigation in the United States].

In Hearings before Select Committee on Irrigation, House of Representatives, Fifty-first Congress, on the General Subject of Irrigation in the United States, pp. 4–5, 16–29 (February 6, 1890), pp. 1–90, 104–116 (February 27, 1890), Washington, 1890, 8°.

Two pamphlets, with similar titles, the one dated February 6 consisting of 38 pp.; that of February 27, 134 pp.

Largely interlocutory. The testimony covers a wide field. "Artesian irrigation on the Great Plains," pp. 71–90.

Reprinted in No. 60.

53. The irrigable lands of the arid region. By Major J. W. Powell, Director of the U. S. Geological Survey.

In Century Illustrated Monthly Magazine for March, 1890, vol. 39, pp. 766–776, New York, 1890, 8°. Map showing principal drainage districts of the arid region.

A long extract appeared in Public Opinion of March 1, 1890.

54. The non-irrigable lands of the arid region. By the Director of the United States Geological Survey.

In Century Illustrated Monthly Magazine for April, 1890, vol. 39, pp. 915–922, New York, 1890, 8°. Map of the forest lands of the arid region.

55. Institutions for the arid lands.

In Century Illustrated Monthly Magazine for May, 1890, vol. 40, pp. 111–116, New York, 1890, 8°.

56. [Data relating to the irrigation problem in western United States.]

In United States Geological Survey, Tenth Annual Report, Part II, passim, Washington, 1890, royal 8°.

No. 49 reprinted on pp. 16–29.

57. Statement of J. W. Powell, Director of the Geological Survey [in relation to irrigation and reclamation of arid lands.]

In Report of the special committee of the United States Senate on the irrigation and reclamation of arid lands [Wm. M. Stewart, chairman], vol. 4, pp. 5–95, Washington, 1890, 8°.

58. Irrigation. Statement of Major J. W. Powell, Director of the Geological Survey. June 4, 1890. [In relation to irrigation in western United States.]

In 51st Congress, 1st session, House of Representatives, Report No. 2407, submitted by Mr. Cannon from the Committee on Appropriations (sundry civil appropriation bill), pp. 53–75, Washington, 1890, 8°.

Largely interlocutory.

59. Irrigation and reclamation of public lands. United States Senate Committee on Appropriations, Wednesday, July 2 [and Friday, July 4], 1890. Statement of Major J. W. Powell, Director of the Geological Survey.

In 51st Congress, 1st session, Senate report No. 1466, submitted by Mr. Allison (sundry civil bill), pp. 46–109, 131–136, Washington, 1890, 8°.

Largely interlocutory.

1891.

60. Hydrography, [hydrographic] engineering, the arid lands, and irrigation literature [a list of books, pamphlets, and articles].

In United States Geological Survey, Eleventh Annual Report, Part II, pp. 1–289, 345–388, Washington, 1891, royal 8°.

"The arid lands" reprinted from No. 52.

1893.

61. History of irrigation. By Major J. W. Powell, Director United States Geological Survey.

In Independent for Thursday, May 4, 1893, pp. 1–3, vol. 45, pp. 593–595, New York, 1893, folio.

The first of eleven articles in the same number of The Independent, each by a different author, constituting a symposium on irrigation.

62. The water and the method.

In Proceedings of the Kansas Irrigation Association, at the Wichita convention, November 22 and 23, 1893, pp. 7–8, Topeka (?), 1893 (?), 8°.

An epitome of an address delivered before the convention November 23.

1894.

63. The water supplies in the arid region. First paper: "The duty of water and the sources of supply." By J. W. Powell, Director of the U. S. Geological Survey.

In Irrigation Age, a Journal of Western America, monthly, illustrated, edited by William E. Smythe, for February, 1894, vol. 6, No. 2, pp. 54–65, Chicago, 1894, 4°. Two maps and one diagram.

64. [Speech of Major J. W. Powell before the "New York Farmers" on the evening of February 20, 1894, at "Sherry's."]

In Proceedings of the New York Farmers, season 1893–1894, pp. 70–79, New York, 1894, 8°.

Deals with the subject of irrigation.

Pp. 1–84 were issued in separate form, with cover and title.

65. The [Omaha] irrigation convention [held March 21–22, 1894]. By Major J. W. Powell, Director United States Geological Survey.

In Harper's Weekly, a Journal of Civilization, for Saturday, March 24, 1894, vol. 38, p. 268, New York, 1894, folio.

66. Ownership of lands in the arid region. By J. W. Powell, Director of the U. S. Geological Survey.

In Irrigation Age for April, 1894, vol. 6, pp. 143–149, Chicago, 1894, 4°. Two maps and three diagrams.

67. The water supply of the Great Plains and its availability for irrigation purposes. By Major J. W. Powell, Director of the U. S. Geological Survey.

In Western America, a monthly journal descriptive of the West and devoted to practical hydraulics in agriculture, manufacturing, mining and commerce, issue for April, 1894, vol. 1, No. 2, pp. 6–9, Omaha, Nebraska, 4°.

An address delivered March 21, 1894, at the Second Annual Convention of the Inter-State Irrigation Association at Omaha, Nebr.

ANTHROPOLOGY AND PHILOSOPHY.

1874.

68. Report of special commissioners J. W. Powell and G. W. Ingalls on the condition of the Ute Indians of Utah; the Paiutes of Utah, northern Arizona, southern Nevada, and southeastern California; the Go-si-utes of Utah and Nevada; the northwestern Shoshones of Idaho and Utah; and the western Shoshones of Nevada; and report concerning claims of settlers in the Mo-a-pa Valley, southeastern Nevada.

Washington: Government Printing Office. 1874.

Cover, title-page, and 36 pp., 8°. The reports are dated December 18, 1873.

69. [Ethnographic data relating to the Indians of western United States.]

In 43d Congress, 1st session, House of Representatives, mis. doc. No. 265, Professor Powell's report on the survey of the Colorado of the West; letter from the Secretary of the Smithsonian Institution, transmitting a report of Professor Powell on the survey of the Colorado River of the West and its tributaries, &c., &c., pp. 19–26, Washington, 1874, 8°. The pamphlet consists of 29 pp., 8°. Professor Powell's report is dated April 30, 1874.

Appeared also in Report of explorations in 1873 of the Colorado of the West and its tributaries, by Professor J. W. Powell, under the direction of the Smithsonian Institution, pp. 25–33, Washington, 1874, 8°. This pamphlet consists of 36 pp., 8°.

1875.

70. [An Indian mythologic story, the So-kus Wai-un-ats, or One-Two Boys.]

In "An overland trip to the Grand Cañon," in Scribner's Monthly, an Illustrated Magazine for the People (conducted by J. G. Holland), for October, 1875, vol. 10, pp. 659–678, New York [1875], 8°.

Also in Explorations of the Colorado River of the West and Its Tributaries, pp. 116–121, Washington, 1875, 4° (see No. 11); and in the revised 1895 edition (see No. 124).

71. [Remarks on the life, customs, mythology, etc., of the Indians of western United States.]

In "The ancient province of Tusayan," in Scribner's Monthly, an Illustrated Magazine for the People (conducted by J. G. Holland), for December, 1875, vol. 11, pp. 193–213, passim, New York [1876], 8°.

1877.

72. Appendix. Linguistics; edited by J. W. Powell.

In United States Geographical and Geological Survey of the Rocky Mountain Region, Contributions to North American Ethnology, vol. 3 (Tribes of California, by Stephen Powers), pp. 439–613, Washington, 1877, 4°.

73. Introduction to the study of Indian languages, with words, phrases, and sentences to be collected. By J. W. Powell.

Washington: Government Printing Office. 1877.

104 pp., 10 additional blank leaves, 4°.

On pp. 3–7 the purpose of this publication is explained, the alphabet recommended is described and commented on, and some explanatory remarks are offered. The schedules are 24 in number — in character such as "persons," "food," "animals," etc. — and usually each schedule is preceded by some remarks or suggestions by the author.

For enlarged edition see No. 80.

1877–1878.

74. Outlines of the philosophy of the North American Indians. By J. W. Powell. Read before the American Geographical Society, at Chickering Hall, December 29th, 1876.

New York: Douglas Taylor, book, job and law printer, cor. Nassau & Fulton sts. 1877.

Cover and 19 pp., 8°.

The following headings appear: savagery is ethnic childhood; the Shin-au-av brothers discuss matters of importance to the people; theology; religion; mythology; origin of the echo.

This is a separate issue of the following:

A discourse on the philosophy of the North American Indians. By Major J. W. Powell, U. S. geologist in charge of Geographical Survey of the Rocky Mountain Region.

In American Geographical Society of New York, Journal, vol. 8, pp. 251–268 [Albany?], 1878, 8°.

1878.

75. Ethnology. [Reasons why ethnologic researches should be fostered by the general government.]

In Report on the methods of surveying the public domain, to the Secretary of the Interior, at the request of the National Academy of Sciences, pp. 15–16, Washington, 1878, 8°. The pamphlet consists of 16 pp., 8°. The report is dated November 1, 1878.

76. The nationality of the Pueblos. By Major J. W. Powell.

In Rocky Mountain Presbyterian, for November, 1878, vol. 7, No. 11, p. 1, col. 2, Denver, Colo., folio.

A classification of the pueblo people of New Mexico and Arizona on a linguistic basis.

1880.

77. 46th Congress, 2d session. House of Representatives. Mis. doc. No. 35. Ethnology of the North American Indians. Letter from the Secretary of the Smithsonian Institution, recommending an appropriation for continuing the ethnologic researches among the North American Indians.

No title-page, heading as given above, 3 pp., 8°. Dated April 2, 1880.

78. [Remarks on the organization of primitive society, called forth by Mr. Dorsey's paper on the gentile system of the Omahas.]

In Philosophical Society of Washington, Bulletin, vol. 3, pp. 137–138, Washington, 1878–1880, 8°.

This Bulletin also forms a part of Smithsonian Miscellaneous Collections, vol. 20.

79. Address of Major John W. Powell, vice-president, Section B. Mythologic philosophy.

In American Association for the Advancement of Science, Proceedings of the Twenty-eighth Meeting, held at Saratoga Springs, N. Y., August, 1879, pp. 251–278, Salem, 1880, 8°.

Sub-headings are: the genesis of philosophy; two grand stages of philosophy; mythologic philosophy has four stages; outgrowths from mythologic philosophy; the evolution of mythologic philosophy.

Issued separately also: cover bearing title, 30 pp., 8°.

Appeared also, with slight changes, as follows:

Mythologic philosophy. By Major J. W. Powell.

In Popular Science Monthly for October and November, 1879, vol. 15, pp. 795–808; vol. 16, pp. 56–66; New York, 1879, 1880, 8°.

80. Smithsonian Institution — Bureau of Ethnology. J. W. Powell, director. Introduction to the study of Indian languages, with words, phrases, and sentences to be collected. By J. W. Powell. Second edition — with charts.

Washington: Government Printing Office. 1880.

228 pp., 10 blank leaves for "additional investigations," 4°.

The text consists of two chapters: (1) On the alphabet, (2) Hints and explanations.

For the first edition see No. 73.

1881.

81. Annual address of the president, J. W. Powell. [February 1,] 1881. On limitations to the use of some anthropologic data.

In Anthropological Society of Washington, abstract of transactions for the first and second years, pp. 113–136; Washington, National Republican printing house, 1881, 8°. This abstract of transactions forms a part of Smithsonian Miscellaneous Collections, vol. 25.

Published also as follows:

Smithsonian Institution — Bureau of Ethnology. J. W. Powell, director. On limitations to the use of some anthropologic data. By. J. W. Powell.

In Bureau of Ethnology, First Annual Report, pp. 71–86, Washington, 1881, royal 8°.

82. Annual address of the president, J. W. Powell. [Delivered March 2, 1880.] On the evolution of language, as exhibited in the specialization of the grammatic processes, the differentiation of the parts of speech, and the integration of the sentence; from a study of Indian languages.

In Anthropological Society of Washington, abstract of transactions for the first and second years, pp. 35–54, Washington, National Republican printing house, 1881, 8°.

Reprinted as follows:

Smithsonian Institution — Bureau of Ethnology. J. W. Powell, Director. On the evolution of language, as exhibited in the specialization of the grammatic processes, the differentiation of the parts of speech, and the integration of the sentence; from a study of Indian languages. By J. W. Powell.

In Bureau of Ethnology, First Annual Report, pp. 1–16, Washington, 1881, royal 8°.

Separates were issued, with cover bearing title.

83. Smithsonian Institution — Bureau of Ethnology. J. W. Powell, Director. Sketch of the mythology of the North American Indians. By J. W. Powell.

In Bureau of Ethnology, First Annual Report, pp. 17–56, Washington, 1881, royal 8°.

Separates were issued, with cover bearing title.

84. Wyandot government — a short study of tribal society. By J. W. Powell.

In Anthropological Society of Washington, abstract of transactions for the first and second years, pp. 76–92, Washington, National Republican printing house, 1881, 8°. Read June 15, 1880. This abstract of transactions forms a part of Smithsonian Miscellaneous Collections, vol. 25.

Sub-headings: the family; the gens; the phratry; government; civil government; methods of choosing and installing councilors and chiefs; functions of civil government; marriage regulation; name regulations; regulations of personal adornment; regulations of order in encampment and migrations; property rights; rights of person; community rights; rights of religion; crimes; theft; maiming; murder; treason; witchcraft; outlawry; military government; fellowhood.

Redelivered and republished as follows:

Address of Professor J. W. Powell, chairman of subsection of anthropology. Wyandotte government. A short study of tribal society.

In American Association for the Advancement of Science, Proceedings of the Twenty-ninth Meeting, held at Boston, Mass., August, 1880, pp. 675–688, Salem, 1881, 8°.

Issued separately: cover bearing title, 16 pp., 8°.

Republished, without essential change, as follows:

Smithsonian Institution—Bureau of Ethnology. J. W. Powell, Director. Wyandot government: a short study of tribal society. By J. W. Powell.

In Bureau of Ethnology, First Annual Report, pp. 57–69, Washington, 1881, royal 8°.

Issued separately, also, with cover bearing title.

1882.

85. Annual address of the president, J. W. Powell. Delivered February 7, 1882. Outlines of sociology.

In Anthropological Society of Washington, Transactions, vol. 1, pp. 106–129, Washington [Judd & Detweiler], 1882, 8°. This volume of Transactions forms a part of Smithsonian Miscellaneous Collections, vol. 25.

Sub-headings: the state; sociologic classes; social ranks; corporations; a state is a plexus of organizations; the government; the law; course of evolution of the state; course of evolution of government; the course of evolution of law; personal law; property law; government law; criminal law.

Issued separately in two forms, one with the original paging (106–129), the other repaged, title and pp. 3–25; both with paper cover bearing title. Appeared also as follows:

Outlines of sociology. Lecture delivered in the National Museum, Washington, D. C., April 1, 1882, by Major J. W. Powell.

In the Saturday Lectures, delivered in the lecture-room of the United States National Museum, under the auspices of the Anthropological and Biological societies of Washington, in March and April, 1882, pp. 60–82, Washington, D. C., Judd & Detweiler, 1882, 8°.

86. Darwin's contributions to philosophy. By John W. Powell.

In Biological Society of Washington, Proceedings, vol. 1, pp. 60–70, Washington, 1882, 8°. This volume of Proceedings forms a part of Smithsonian Miscellaneous Collections, vol. 25.

Sub-headings are: [philosophy, and the philosophies of the world]; origin of metaphysic philosophy; the origin of scientific philosophy; working hypotheses.

Issued separately, text unchanged, with the following title:

The philosophic bearings of Darwinism, an address delivered by John Wesley Powell before the Biologic Society of Washington at the Darwin memorial meeting, May 12, 1882.

Washington: Judd & Detweiler, printers. 1882.

Cover and inner titles, pp. 3–13, 8°.

1883.

87. [Review of] Ward's Dynamic Sociology.

In Science for July 13, July 27, August 10, and August 24, 1883, vol. 2, pp. 45–49, 105–108, 171–174, 222–226, Cambridge, Mass., 1883, 4°. In four parts.

88. A classification of the sciences. By J. W. Powell of Washington, D. C.

In Science for September 14, 1883, vol. 2, p. 370, Cambridge, Mass., 1883, 4°.

A brief abstract of a paper read at the Minneapolis meeting of the American Association for the Advancement of Science in August, 1883.

See also No. 153.

89. Annual address of the president, J. W. Powell, delivered November 6, 1883. Human evolution.

In Anthropological Society of Washington, Transactions, vol. 2, pp. 176–208, Washington, 1883, 8°.

Sub-topics are: the sources of human history; the early condition of man; the genesis of activities; evolution of arts; evolution of institutions; the evolution of language; evolution of philosophy; evolution of mind.

Issued separately, with cover and inner titles.

1884.

90. Annual address of the president, J. W. Powell, delivered December 8, 1883. The three methods of evolution.

In Philosophical Society of Washington, Bulletin, vol. 6, pp. xxvii–lii, Washington, 1884, 8°. This bulletin forms the first part of Smithsonian Miscellaneous Collections, vol. 33.

Sub-topics are: the kinematic hypothesis; combination of matter; modes of motion; the relation of motion to combination; change of combination; change of motion; evolution defined; evolution in the physical kingdom; evolution in the biotic kingdom; evolution in the anthropic kingdom.

Issued separately (date 1883), with cover and inner titles.

91. On kinship and the tribe; On kinship and the clan; Tribal marriage law; On activital similarities.

In Bureau of Ethnology, Third Annual Report, pp. xxxviii–xlv, xlvi–lv, lvi–lxii, lxv–lxxiv, Washington, 1884, royal 8°.

Included in paper-covered separates of the Director's report.

92. Certain principles of primitive law.

In Science for November 7, 1884, vol. 4, pp. 436–437, Cambridge, Mass., 1884, 4°.

93. Marriage law in savagery.

In Science for November 21, 1884, vol. 4, pp. 471–473, Cambridge, Mass., 1884, 4°.

1885.

94. Inheritance among the ancient Arabs.

In Science for January 2, 1885, vol. 5, pp. 16–18, Cambridge, Mass., 1885, 4°.

A review of "Das Matriarchat (das Muterrecht) bei den alten Arabern," by G. A. Wilken, Leipsic, 1884, 72 pp., 8°.

95. From savagery to barbarism. Annual address of the president, J. W. Powell, delivered February 3, 1885.

In Anthropological Society of Washington, Transactions, vol. iii, pp. 173–196, Washington, 1885, 8°.

After a discussion of culture stages the following sub-topics are treated: arts of savagery; institutions of savagery; the language of savagery; the philosophy of savagery; psychic operations of savagery; [the change in arts in passing from savagery to barbarism;] [the change in institutions in passing from savagery to barbarism;] the change in language; the change in philosophy; the psychic change; [human evolution as distinguished from animal evolution.]

Issued separately, with cover and inner titles.

96. The Indians are the mound-builders.

In Science for April 3, 1885, vol. 5, p. 267, Cambridge, Mass., 1885, 4°.

97. The patriarchal theory.

In Science for April 24, 1885, vol. 5, pp. 345–348, Cambridge, Mass., 1885, 4°.

A review of "The patriarchal theory. Based on the papers of the late John Ferguson McLennan," London, 1885, 365 pp., 8°.

98. On the organization of the tribe. By J. W. Powell.

In Scientific American Supplement for June 20, 1885, vol. 19, pp. 7889–7891, New York, 1885, 4°.

Read before the National Academy of Sciences, at Washington, April 22, 1885.

Consists of an explanation of the fundamental principles of tribal kinship, including several characteristics of the clan.

1886.

99. Conn's Evolution of To-Day.

In Science for September 17, 1886, vol. 8, pp. 264–265, New York, 1886, 4°.

A review of "Evolution of to-day," by H. W. Conn, Ph.D., New York, 1886, 8°.

1887.

100. Museums of ethnology and their classification.

In Science for June 24, 1887, vol. 9, pp. 612–614, New York, 1887, 4°.

1888.

101. From barbarism to civilization. By J. W. Powell, director U. S. Bureau of Ethnology.

In American Anthropologist for April, 1888, vol. 1, pp. 97–123, Washington, 1888, 8°. Delivered March 16, 1886, as annual address of retiring president of the Anthropological Society of Washington.

After pointing out "certain errors in the current literature of anthropology," the course of cultural progress involved in the transition from barbarism to civilization is discussed under the following headings: the change in arts; the change in institutions; the change in language; the change in opinions; the change of mentations.

Issued separately, without title or change of heading or pagination.

This lecture, slightly changed, was also delivered in the National Museum at Washington May 5, 1888, as one of the course of free lectures under the auspices of the Philosophical, Biological, and Anthropological societies of Washington, and a lengthy extract from the same, under the heading "The course of human progress," appeared in Science for May 11, 1888, vol. 11, pp. 220–222, New York, 1888, 4°.

102. Competition as a factor in human evolution. Annual address of the retiring president, Major J. W. Powell [of the Anthropological Society of Washington].

In American Anthropologist for October, 1888, vol. 1, pp. 297–323, Washington, 1888, 8°.

A lengthy extract appeared in Science for March 9, 1888, vol. 11, pp. 112–116, New York, 1888, 4°.

Issued separately without title or change of heading or pagination; also with a cover bearing title, otherwise unchanged.

1890.

103. Address by J. W. Powell, the retiring president of the Association. Evolution of music from dance to symphony.

In American Association for the Advancement of Science, proceedings thirty-eighth meeting, held at Toronto, August, 1889, pp. 1–21, Salem, July, 1890, 8°.

Read at Toronto by G. K. Gilbert, Major Powell being detained in the West by official duties.

Separates were issued (dated 1889): cover and inner titles, pp. 3–23.

104. Prehistoric man in America.

In Forum for January, 1890, vol. 8, pp. 489–503, New York, 1890, 8°.

105. Problems of American archæology.

In Forum for February, 1890, vol. 8, pp. 638–652, New York, 1890, 8°.

A lengthy extract appeared in Public Opinion for February 8, 1890.

106. The humanities.

In Forum for December, 1890, vol. 10, pp. 410–422, New York [1891], 8°.

See No. 120.

1891.

107. The four modes of life.

In Forum for February, 1891, vol. 10, pp. 667–677, New York [1891], 8°.

108. The study of Indian languages.

In Science for February 6, 1891, vol. 17, pp. 71–74, New York, 1891, 4°.

An exposition of the classification the Bureau of Ethnology is attempting of the languages and dialects of the Indian tribes north of Mexico.

109. The growth of sentiency.

In Forum for April, 1891, vol. 11, pp. 157–167, New York, 1891, 8°.

110. Indian linguistic families of America north of Mexico. By J. W. Powell.

In Bureau of Ethnology, Seventh Annual Report, pp. 1–142, map, Washington, 1891, royal 8°. The paper was also issued in separate form, with paper cover bearing title.

Chief headings are: nomenclature of linguistic families; literature relating to the classification of Indian languages; linguistic map; linguistic families; concluding remarks.

"Within the area covered by the map there are recognized fifty-eight distinct linguistic families. These are enumerated in alphabetical order, and each is accompanied by a table of the synonyms of the family name, together with a brief statement of the geographical area occupied by each family so far as it is known. A list of the principal tribes of each family also is given."

1892.

111. Remarks on the classification and nomenclature of anthropology.

In American Anthropologist for July, 1892, vol. 5, pp. 266–271, Washington, Judd & Detweiler, 1892, 8°.

1893.

112. Simplified spelling.

In American Anthropologist for April, 1893, vol. 6, pp. 193–195, Washington, 1893, 8°.

One of twelve addresses — a symposium.

Some separates were issued of the whole symposium (pp. 137–206), without cover, and without change except the addition at the top of the first page (137) of the line "[From the American Anthropologist for April, 1893.]"

113. Are our Indians becoming extinct?

In Forum for May, 1893, vol. 15, pp. 343–354, New York, 1893, 8°.

114. Are there evidences of man in the glacial gravels? By Major J. W. Powell.

In Popular Science Monthly for July, 1893, vol. 43, pp. 316–326, New York, 1893, 8°.

1894.

115. On the nature of motion.

In Monist for October, 1894, vol. 5, pp. 55–64, Chicago, 8°.

116. [History of the "mound builders" question, and statement of the writer's conclusions.]

In Bureau of Ethnology, Twelfth Annual Report, pp. xxxix–xlviii, Washington, 1894, royal 8°.

Included in paper-covered separates of Director's report.

117. The North American Indians.

In Shaler (N. S.), editor, The United States of America, A Study of the American Commonwealth, etc., in two volumes, vol. 1, pp. 190–272, New York, D. Appleton and Company, 1894. Illustrated.

Sub-topics are: origin of the Indians, Indian sociology, mythology and religion, Indian languages, Indian history and migrations, Indian population, Indian villages and their distribution, Indian architecture, mounds and mound builders, subsistence of the Indians, domestication of animals by Indians, Indian technology, Indian costumes and adornments, Indian art of war, Indian modes of transportation, Indian music, general conclusions.

118. Immortality.

In Open Court for December 27, 1894, vol. 8, pp. 4335–4337, Chicago, 8°.

In verse, partly blank, partly rimed. Sub-headings are: heredity, labor, pleasure, language, justice, culture, adaptation, effort, design.

Issued in separate form: title (1895) and 12 pp., 12°.

1895.

119. Proper training and the future of the Indians.

In Forum for January, 1895, vol. 18, pp. 622–629, New York, 8°.

120. The humanities.

In Science for January 4, 1895, new series, vol. 1, pp. 15–18, New York, 4°.

The humanities treated in this paper are industries, pleasures, languages, institutions, and opinions, the five great branches into which, the author says, the study of the history of mankind is logically developed.

See No. 106.

121. Stone art in America. By J. W. Powell, Director of the Bureau of American Ethnology.

In American Anthropologist for January, 1895, vol. 8, pp. 1–7, Washington, 1895, 8°.

Separates issued: no cover, 7 pp., 8°.

122. The five books of history.

In Science for February 8, 1895, new series, vol. 1, pp. 157–161, New York, 4°.

"Modern history resorts to the Stone Book, the Ruin Book, the Tomb Book, the Folk Book, and the Scripture Book for the materials to be used in discovering and formulating the development of the industries, pleasures, languages, institutions, and opinions of mankind."

123. The Soul.

In Monist for April, 1895, vol. 5, No. 3, appendix, pp. 1–16, Chicago, 8°.

In verse, partly blank and partly rimed. Sub-headings are: allegory, soul forces, awareness, memory, sensation, perception, understanding, reflexion, acception, introspection, conception, the mind, the will, becoming of soul.

124. [Information concerning the life, dwellings, beliefs, etc., of various tribes of Indians in western United States.]

In Canyons of the Colorado, by J. W. Powell, Ph.D., LL.D., formerly Director of the United States Geological Survey, [etc.], passim, Meadville, Pa., The Chautauqua Century Press, 1895, size 11¼ by 8½ inches.

The mythologic story "The So'kus Wai' u nats," or One-Two Boys, pp. 303–311. — Government among the tribes of the seven pueblos of Tusayan — Oraibi, Shumopavi, Shupaulovi, Mashongnavi, Walpi, Sichumovi, and Hano, pp. 356–364.

The book is profusely illustrated. It is a revised and enlarged edition of the report published in 1875 (see title No. 11). Several of the chapters, descriptive of the region and of the people who inhabit it, were written expressly for this edition, making it a distinct publication.

1896.

125. Certitudes and illusions. Chuar's illusion.

In Science for February 21, 1896, new series, vol. 3, pp. 263–271, New York, 4°.

Sub-topics are: substrate, essence, space, force, time, ghost, cause.

126. Seven venerable ghosts. By J. W. Powell.

In American Anthropologist for March, 1896, vol. 9, pp. 67–91, Washington, 1896, 8°.

Address of the retiring president before the Anthropological Society of Washington, February 4, 1896.

The "ghosts" are substrate, essence, space, force, time, spirit, cause.

Issued in separate form, with paper cover bearing title.

127. Certitudes and illusions: An illusion concerning rest.

In Science for March 20, 1896, new series, vol. 3, pp. 426–433, New York, 4°.

"Without the consideration of other unseen facts, rest seems to be a state without motion, and it appears that motion can be created and destroyed. This is the illusion to be dispelled. It is proposed to demonstrate that acceleration in molar motion is deflection of molecular motion, and in general that acceleration in any body is deflection in the particles of the body."

128. Certitudes and illusions. [Discussion and correspondence.]
In Science for April 11, 1896, new series, vol. 3, pp. 595–596, New York, 4°.

129. Relation of primitive peoples to environment, illustrated by American examples. By J. W. Powell.
In Smithsonian Report for 1895, pp. 625–637, Washington, 8°.
Saturday lecture in Assembly Hall of the United States National Museum, April 25, 1896.
Issued in separate form, with cover and inner titles. Also included in Smithsonian pamphlet No. 1064, entitled "Relations of human life to environment," which consists of pp. 625–711 from same report.

130. The absolute and the relative.
In Science for May 15, 1896, new series, vol. 3, pp. 743–745, New York, 1896, 8°.

131. The subject of consciousness.
In Science for June 5, 1896, new series, vol. 3, pp. 845–847, New York, 4°.

132. On primitive institutions. By Major J. W. Powell. Director of the Bureau of American Ethnology, Smithsonian Institution.
In American Bar Association, Report of the Nineteenth Annual Meeting, held at Saratoga Springs, N. Y., August 19, 20 and 21, 1896, pp. 573–593, Philadelphia, 1896, 8°.
Read on August 21 before the section on legal education. Issued separately: cover and 21 pp., 8°.

133. [Classification of the native tribes on a demotic or human basis as distinguished from a biotic or somatologic basis.]
In Bureau of Ethnology, Fourteenth Annual Report, Part I, pp. xxvii–xxx, Washington, 1896, royal 8°.
Included in paper-covered separates of Director's report.
Restated in the Fifteenth Annual Report, pp. xvii–xix, Washington, 1897, royal 8°.

1897.

134. [Demonomy, or the science of humanity.]
In Bureau of Ethnology, Fifteenth Annual Report, pp. xvii–xix, Washington, 1897, royal 8°.

Included in paper-covered separates of Director's report.

135. On regimentation.

In Bureau of Ethnology, Fifteenth Annual Report, pp. civ–cxxi, Washington, 1897, royal 8°.

Included in paper-covered separates of Director's report.

136. The five categories of human activities — esthetology, technology, sociology, philology, and sophiology.

In Bureau of American Ethnology, Sixteenth Annual Report, pp. xv–xviii, Washington, 1877, royal 8°.

Included in paper-covered separates of Director's report.

Restated, more fully, in Seventeenth Annual Report, Part I, pp. xxvii–xxxviii, Washington, 1898, royal 8°.

1898.

137. Whence came the American Indians?

In Forum for February, 1898, vol. 24, pp. 676–688, New York, 8°.

138. Forest dwellers — Indians. By Major J. W. Powell, former Director of U. S. Geological Survey.

In Nature and Art (conducted by John M. Coulter, Ph.D.) for February, 1898, pp. 48–51, Chicago, 4°.

139. Truth and error, or the science of intellection. By J. W. Powell.

Chicago: The Open Court Publishing Company. (London: Kegan Paul, Trench, Trübner & Co.) 1898.

428 pp., 12°.

Chapter headings are: Chuar's illusion; essentials of properties; quantities, or properties that are measured; kinds, or properties that are classified; processes, or the properties of geonomic bodies; generations or properties of plants; principles or properties of animals; qualities; classification; homology; dynamics; coöperation; evolution; sensation; perception; apprehension; reflection; ideation; intellections; fallacies of sensation; fallacies of perception; fallacies of apprehension; fallacies of reflection; fallacies of ideation; summary.

140. How a savage tribe is governed.

Proc. Wash. Acad. Sci., July, 19c3.

In Forum for August, 1898, vol. 25, pp. 712–722, New York, 8°.

141. Chuar's illusion. By Major J. W. Powell.

In Open Court for October, 1898, vol. 12, pp. 577–581, Chicago, 8°.

A philosophical sketch.

142. Intellections. A psychological study. By Major J. W. Powell.

In Open Court for November, 1898, vol. 12, pp. 641–652, Chicago, 8°.

143. Fallacies of perception. By Major J. W. Powell.

In Open Court for December, 1898, vol. 12, pp. 720–729, Chicago, 8°.

A psychological investigation of illusions, hallucinations, ghosts, etc.

1899.

144. Esthetology, or the science of activities designed to give pleasure. By J. W. Powell.

In American Anthropologist for January, 1899, new series, vol. 1, pp. 1–40, New York, 1899, 8°.

Sub-topics are: ambrosial pleasures, decorative pleasures, athletic pleasures, games, fine arts (music, graphic art, drama, romance, poetry).

Issued in separate form, with paper cover bearing title.

Published also in Bureau of American Ethnology, Nineteenth Annual Report, Part I, pp. lv–xcii, Washington, 1900, royal 8°.

Included in paper-covered separates of Director's report.

145. Reply to critics [of "Truth and Error"].

In Science for February 17, 1899, new series, vol. 9, pp. 259–263, New York, 4°.

146. Technology, or the science of industries. By J. W. Powell.

In American Anthropologist for April, 1899, vol. 1, new series, pp. 319–349, New York, 1899, 8°.

Sub-topics are: substantiation, construction, mechanics, commerce, medicine.

Issued in separate form, with paper cover bearing title.
See last paragraph under No. 151.

147. Sociology, or the science of institutions, by J. W. Powell.
In American Anthropologist for July and October, 1899, new series, vol. 1, pp. 475–509, 695–745, New York, 1899, 8°.
Sub-topics are: statistics, economics, civics, historics (savagery, barbarism, monarchy, republickism), ethics.
Issued in separate form, with paper cover bearing title.

1900.

148. The lessons of folklore. By J. W. Powell.
In American Anthropologist for January, 1900, new series, vol. 2, pp. 1–36, New York, 1900, 8°.
Issued in separate form, with paper cover bearing title.

149. [Statement of the character of the fraternities, and of the clans, gentes, tribes, and confederacies, of the North American Indians.]
In Bureau of American Ethnology, Nineteenth Annual Report, Part I, pp. xlvi–l, Washington, 1900, royal 8°.
Included in paper-covered separates of Director's report.

150. Philology, or the science of activities designed for expression. By J. W. Powell.
In American Anthropologist for October-December, 1900, new series, vol. 2, pp. 603–637, New York, 1900, 8°.
Sub-topics are: emotional language, oral language (phonics, lexicology, grammar, etymology, sematology, the Aryan problem), gesture language, written languages, logistic language.
Issued in separate form, with paper cover bearing title.

1901.

151. Sophiology, or the science of activities designed to give instruction. By J. W. Powell.
In American Anthropologist for January–March, 1901, new series, vol. 3, pp. 51–79, New York, 1901, 8°.
Sub-topics are: opinions, or the subject-matter of instruction; mythology, metaphysic, science, instruction (nurture, oratory, education, publication, research).
Issued in separate form, with paper cover bearing title.

Nos. 146, 147, 150, and 151 (Technology, Sociology, Philology, and Sophiology) will appear also in Bureau of American Ethnology, Twentieth Annual Report, pp. ———, Washington, 1903, royal 8°. Not yet published.

152. The categories. By J. W. Powell.

In American Anthropologist for July–September, 1901, new series, vol. 3, pp. 404–430, New York, 1901, 8°.

Sub-topics are: how bodies are resolved into particles; how concrete objects are resolved into abstract objects; relations; absolutes are constant and relations are variable; quantities; properties; qualities; the development of attributes; the fundamental classes of bodies; categorical axioms; evolutional axioms.

Issued in separate form, with paper cover bearing title.

153. Classification of the sciences. By J. W. Powell.

In American Anthropologist for October–December, 1901, new series, vol. 3, pp. 601–605, New York, 1901, 8°.

See, also, No. 88.

1902.

154. An American view of totemism. By J. W. Powell, Director of the Bureau of American Ethnology, Washington.

In Man, a Monthly Record of Anthropological Science, London, July, 1902, article No. 75, pp. 101–106, large 8°.

ADMINISTRATION: REPORTS AND TESTIMONY.

1867.

155. Scientific expedition to the Rocky Mountains. Preliminary report of Prof. J. W. Powell to the Illinois State Board of Education.

No title-page, heading as above, 4 pp., 8°. Dated Normal, Illinois, December 18, 1867.

The only copy known to the compiler is in the library of the United States Geological Survey.

1872.

156. 42d Congress, 2d session. House of Representatives. Mis. doc. No. 173. Survey of the Colorado River of the West. Letter from the Secretary of the Smith-

sonian Institution, transmitting report preliminary for continuing the survey of the Colorado of the West and its tributaries, by Professor Powell.

No title-page, heading as above, 12 pp., 8°. Dated Washington, D. C., March 25, 1872.

1873.

157. 42d Congress, 3d session. House of Representatives. Mis. doc. No. 76. Report of the survey of the Colorado of the West. Letter from the Secretary of the Smithsonian Institution, transmitting a report [by Professor Powell] of the survey of the Colorado of the West, and its tributaries.

No title-page, heading as above, 16 pp., 8°. Dated January 17, 1873.

A part of the report is devoted to ethnologic studies.

1874.

158. Report of special commissioners J. W. Powell and G. W. Ingalls on the condition of the Ute Indians of Utah; the Pai-utes of Utah, northern Arizona, southern Nevada, and southeastern California; the Go-si-utes of Utah and Nevada; the northwestern Shoshones of Idaho and Utah; and the western Shoshones of Nevada; and report concerning claims of settlers in the Mo-a-pa Valley, southeastern Nevada.

Washington: Government Printing Office. 1874.

Cover, title-page, and 36 pp., 8°. The reports are dated December 18, 1873.

159. 43d Congress, 1st session. House of Representatives. Mis. doc. No. 265. Professor Powell's report on the survey of the Colorado of the West. Letter from the Secretary of the Smithsonian Institution, transmitting a report of Professor Powell on the survey of the Colorado River of the West and its tributaries, &c., &c.

No title-page, heading as above, 29 pp., 8°. Dated April 30, 1874.

Relates to topography, geology, ethnography, natural history, photography, progress of the office work, and what is necessary for the completion of the work.

Issued also (with more lead between the lines) as follows:

Report of explorations in 1873 of the Colorado of the West and its tributaries by Professor J. W. Powell, under the direction of the Smithsonian Institution.

Washington: Government Printing Office. 1874.

Cover and 36 pp., 8°.

The text is headed: "Report of Professor Powell on the survey of the Colorado of the West."

160. 43d Congress, 1st session. House of Representatives. Report No. 612. Geographical and Geological Surveys West of the Mississippi. May 26, 1874. Referred to the Committee on Appropriations and ordered to be printed.

No title-page, heading as above, 91 pp., 8°.

Contains letters and statements from J. W. Powell: in regard to the advisability of consolidating the different government surveys, pp. 9–10; account of work done by parties under his charge, pp. 46–56.

1875.

161. Survey under Professor Powell.

In Smithsonian Institution, Annual Report for the year 1874, pp. 40–42, Washington, 1875, 8°.

"Continuation of the geological and geographical exploration of the basin of the Colorado of the West in Utah." Gives "interesting ethnological results obtained."

1877.

162. Report on the Geographical and Geological Survey of the Rocky Mountain region, by J. W. Powell.

Washington: Government Printing Office. 1877.

Cover and 19 pp., 8°, map.

The report is dated November 25, 1877, and relates to the field season of 1876, office work of 1876–'77, and field season of 1877.

1878.

163. Geographical and Geological Survey of the Rocky Mountain Region, by Prof. J. W. Powell, in 1877.

In Smithsonian Institution, Annual Report for the year 1877, pp. 67–87, Washington, 1878, 8°.

A portion is devoted to "ethnographic work," pp. 82–86.

164. 45th Congress, 2d session. House of Representatives. Ex. doc. No. 80. Geological and geographical surveys. Letter from the Secretary of the Interior, transmitting a report of Professor Powell in regard to surveys, in response to a resolution of the House of Representatives.

No title-page, heading as above, 19 pp., 8°, map.

The report is dated April 27, 1878, and its sub-headings are: areas of territory surveyed: the years in which the districts or areas were surveyed; the cost incurred by direct appropriations made by Congress; aid received from the Ordnance, Commissary, and Quartermaster's departments, outside of direct appropriations; the funds from which transportation and office rents have been paid; list of publications made and in progress as the result of such surveys; duplication of other public geological and geographical surveys made by authority of Congress.

165. Geographical and Geological Survey of the Rocky Mountain Region, under the direction of Professor J. W. Powell. Account of work performed during the year 1877.

In American Journal of Science and Arts for May and June, 1878, 3d series, vol. 15, pp. 342–358, 449–455, New Haven, 1878, 8°.

166. Report on the methods of surveying the public domain, to the Secretary of the Interior, at the request of the National Academy of Sciences. By J. W. Powell, 1878.

Washington: Government Printing Office. 1878.

Cover, title, and pp. 3–16, 8°.

The report is dated November 1, 1878, and treats of: The unification of the work of surveying and mapping the territories; cost of a geographical and geological survey; zoölogy and botany; ethnology.

1879.

167. Geographical and Geological Survey of the Rocky Mountain Region, by Prof. J. W. Powell.

In Smithsonian Institution, Annual Report for 1878, pp. 79–81, Washington, 1879, 8°.

1880.

168. 46th Congress, 2d session. House of Representatives. Mis. doc. No. 35. Ethnology of the North American Indians. Letter from the Secretary of the Smithsonian Institution, recommending an appropriation for continuing the ethnologic researches among the North American Indians.

No title-page, heading as given above, 3 pp., 8°. Dated April 2, 1880.

1881.

169. First annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1879–80].

In Bureau of Ethnology, First Annual Report, pp. xi–xxxiii, Washington, 1881, royal 8°.

Gives a brief history of government ethnologic work and an outline of the different branches of work in progress in the bureau.

Separates were issued, with cover bearing title.

1882.

170. [Second annual] Report of the Director of the United States Geological Survey [for the fiscal year 1880–81].

In United States Geological Survey, Second Annual Report, pp. i–lv, 7 plates, Washington, 1882, royal 8°.

Makes reference to Mr. King's resignation from the Directorship and Mr. Powell's appointment thereto, and to the plan of operations instituted by the former and continued by the latter; then presents a summary of the studies and proposed publications of the leading members of the geologic corps; and finally sets forth the proposed plan of publication, especially the general nomenclature, colors for geologic cartography, and conventional characters for diagrams.

Separates were issued, with paper cover bearing title.

1883.

171. Second annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1880–81].

In Bureau of Ethnology, Second Annual Report, pp. xv–xxxvii, Washington, 1883, royal 8°.

Chief headings are: introductory; publications; linguistic work; ethnologic work; field work; papers accompanying this report; classification of expenditures.

Separates were issued, with cover bearing title.

172. [Third annual] report of the Director of the United States Geological Survey [for the fiscal year 1881–82].

In United States Geological Survey, Third Annual Report, pp. iii–xviii, Washington, 1883, royal 8°.

Separates were issued, with cover bearing title, but they include the administrative reports of chiefs.

1884.

173. United States Geological Survey [an account of its operations].

In Smithsonian Institution, Annual Report of the Board of Regents for the year 1882, pp. 47–49, Washington, 1884, 8°.

174. [Fourth annual] report of the Director of the United States Geological Survey [for the fiscal year 1882–83].

In United States Geological Survey, Fourth Annual Report, pp. iii–xxxii, Washington, 1884, royal 8°.

Principal divisions: introduction, topographic work, geologic work, paleontologic work, chemic work, statistics.

Separates issued, with paper cover bearing title, but they include the reports of chiefs.

175. Third annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1881–82].

In Bureau of Ethnology, Third Annual Report, pp. xiii–lxxiv, Washington, 1884, royal 8°.

Treats the customary subjects and, in addition, the following: on kinship and the tribe, pp. xxxviii–xlv; on kinship and the clan, pp. xlvi–lv; tribal marriage law, pp. lvi–lxii; on activital similarities, pp. lxv–lxxiv.

Separates issued, with paper cover bearing title.

1885.

176. [Letter from the Director of the Geological Survey, giving a statement of the organization of the United States Geological Survey and an outline of its operations.]

In National Academy of Sciences, report for the year 1884, pp. 48–50, Washington, 1885, 8°.

The letter is dated "Hotel Lafayette, Philadelphia, September 8, 1884," and is addressed to General M. C. Meigs, chairman committee National Academy of Sciences.

Reprinted in No. 183, "Testimony before a joint commission," etc.; also largely embodied in the following:

177. The organization and plan of the United States Geological Survey, by J. W. Powell. With a map (plate 1). (Communicated to the National Academy of Sciences at the October meeting [at Newport, R. I.] in 1884.)

In American Journal of Science for February, 1885, 3d series, vol. 29, pp. 93–102, New Haven, 1885, 8°.

Sub-headings are: a topographic map of the United States; paleontology; chemistry; physical researches; lithology; statistics; illustrations; library; publications; general geology; economic geology; employés; appointments; the relation of the government survey to state surveys.

Separates were issued.

178. The administration of the scientific work of the general government.

In Science for January 16, 1885, vol. 5, pp. 51–55, Cambridge, Mass., 1885, 4°.

179. [Fifth annual] report of the Director of the United States Geological Survey [for the fiscal year 1883–84].

In United States Geological Survey, Fifth Annual Report, pp. iii–xxxvi, Washington, 1885, royal 8°.

Treats of: topographic work, geologic work, paleontologic work, chemic work, statistics, preliminary geologic map of the United States and thesaurus of American formations; bibliography of North American geology, the publications of the Survey, library, photographic work, financial statement.

Separates were issued, with paper cover bearing title, but they include the reports of chiefs.

180. Bureau of Ethnology [and] United States Geological Survey [accounts of their operations].

In Smithsonian Institution, Annual Report for 1883, pp. 56–81, Washington, 1885, 8°.

181. Bureau of Ethnology [and] United states Geological Survey [accounts of their operations].

In Smithsonian Institution, Annual Report for the year 1884, pp. 67–95, Washington, 1885, 8°.

182. [Sixth annual] Report of the Director of the United States Geological Survey [for the fiscal year 1884–85].

In United States Geological Survey, Sixth Annual Report, pp. iii–xxix, Washington, 1885, royal 8°.

Divisions are: topography, paleontology, chemistry, physical researches, lithology, statistics, illustrations, library, publications, general geology, economic geology, appointments, government and state surveys, office of the Survey, financial statement, reports of operations.

Separates were issued, with paper cover bearing title, but they include the reports of chiefs.

1885–1886.

183. On the organization of scientific work of the general government, by John W. Powell, Director of the U. S. Geological Survey. Extracts from the testimony taken by the joint commission of the Senate and House of Representatives to "consider the present organization of the Signal Service, Geological Survey, Coast and Geodetic Survey, and the Hydrographic Office of the Navy Department, with the view to secure greater efficiency and economy of administration."

Washington: Government Printing Office. 1885.

Cover and title, pp. 1–49, 162–180, 184–209, 378–451 (index), 460–468, 8°, map.

This is a separate issue of a portion of the "Testimony before a joint commission" (see below).

The remaining pages of the testimony (637–700, 896–912, 1019–1045, 1070–1084) were likewise thrown together and issued as another separate, having printed cover and inside title identical with those of the first separate with the exception of the addition between "survey" and "Extracts" of the following line: "Part 2 — Additional statements." No index.

Testimony before a joint commission consisting of Messrs. Allison (chairman), Hale, and Pendleton [later, Morgan in place of Pendleton], of the U. S. Senate; and Lowry, Herbert, and Lyman [later, Wait in place of Lyman], of the U. S. House of Representatives.

In Senate mis. doc. No. 82, 49th Congress, 1st session, Testimony before the joint commission to consider the present organizations of the Signal Service, Geological Survey, Coast and Geodetic Survey, and the Hydrographic Office of the Navy Department, with a view to secure greater efficiency and economy of administration of the public service in said bureaus, authorized by the sundry civil act approved July 7, 1884, and continued by the sundry civil act approved March 3, 1885, pp. 1–49, 162–180, 184–209, 378–451, 637–700, 896–912, 1019–1045, 1070–1084, Washington, Government Printing Office, 1886, 8°, map.

Besides the testimony proper before the committee, there appears on (preliminary) pp. 26* and 27* of the same volume the "Letter," described under No. 176.

1886.

184. The Geological Survey. [Remarks, May 13, 1886, before the joint commission (Senator Allison, chairman) to consider the organization of the scientific bureaus of the government; being chiefly a discussion of the bill (H. R. 8320) introduced by Mr. Herbert, April 26, 1886, and by him reported with an amendment May 5, 1886.]

No title; heading, "the Geological Survey"; pp. 1–33, 8°.

Sub-beadings are: provisions of the bill; the publications of the Geological Survey are made with great economy; cost of field work and publication, respectively, in the geologic surveys of certain States; [a substitute bill for the one under discussion.]

185. [Statement traversing certain averments of House report No. 2214, forty-ninth Congress, first session, signed by the Hon. Hilary A. Herbert and the Hon. Jno. T. Morgan, presented to the House of Representatives April 26, 1886, in conjunction with a bill (H. R. 8320) "restricting the work and publications of the Geological Survey, and for other purposes."]

In Report No. 2740, House of Representatives, 49th Congress, 1st session, to accompany bills H. R. 9372 and H. R.

9373, limiting the printing and engraving for the Geological Survey, the Coast and Geodetic Survey, the Hydrographic Office of the Navy Department, and the Signal Service, also providing for appointments of second lieutenants in signal corps, pp. 98–125, Washington, Government Printing Office, 1886, 8°.

Headings are: can we follow the example of the present British survey in the United States? the cost of the Geological Survey; expense of the publications of the Survey; the number of sheets in the map of the United States; progress of the survey; economic work of the Geological Survey; geodetic basis for the topographic map; altitudes in Canada; sale of publications; employment of experts for special studies; geological dictatorship.

186. Fourth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1882–83].

In Bureau of Ethnology, Fourth Annual Report, pp. xxvii–lxiii, Washington, 1886, royal 8°.

Treats the usual subjects.

Separates were issued, with paper cover bearing title.

1887.

187. [Statement of the organization, business methods, and work of the United States Geological Survey, by J. W. Powell, Director. Dated August 23, 1887.]

In Report of the Secretary of the Interior in response to inquiries of select committee of United States Senate [F. M. Cockrell, chairman], appointed in pursuance of resolution of the Senate adopted March 3, 1887, to inquire into and examine the methods of business and work of the executive departments, pp. 377–409, Washington, Government Printing Office, 1887, 8°.

General headings: introductory remarks; general plan of the Survey; scientific organization; business organization and methods; business transacted.

Separates were issued, without change.

188. Fifth annual Report [of the Director] of the Bureau of Ethnology [for the fiscal year 1883–84].

In Bureau of Ethnology, Fifth Annual Report, pp. xvii–liii, Washington, 1887, royal 8°.

Treats the usual subjects.

Separates were issued, with paper cover bearing title.

1888.

189. [Report, (dated May 3, 1888) to the Secretary of the Interior concerning "what appropriation is necessary to enable the United States Geological Survey to carry into effect the joint resolution . . . approved March 20, 1888 . . . "]

In Senate ex. doc. No. 163, 50th Congress, 1st session, Letter from the Secretary of the Interior, transmitting, in response to Senate resolution of March 27, 1888, report relative to reservoirs for the storage of water in the arid regions of the United States, pp. 2–6, Washington, Government Printing Office, 1888, 8°.

The pamphlet consists of 6 pp, 8°.

190. Seventh annual report of the Director of the United States Geological Survey [for the fiscal year 1885–86].

In United States Geological Survey, Seventh Annual Report, pp. iii–xx, 2–42, Washington, 1888, royal 8°.

Principal subheadings are: remarks on the plan and organization of the Survey, topographic work, geologic work, paleontologic work, miscellaneous, financial statement.

Separates were issued, with paper cover bearing title, but they include the reports of chiefs.

191. Sixth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1884–85].

In Bureau of Ethnology, Sixth Annual Report, pp. xxiii–lviii, Washington, 1888, royal 8°.

Relates to the usual subjects.

Separates were issued, with paper cover bearing title.

1889.

192. Preliminary report [dated Dec. 31, 1888] on the organization and prosecution of the survey of the arid lands for purposes of irrigation.

In Senate ex. doc. No. 43, 50th Congress, 2d session, Letter from the Secretary of the Interior, transmitting, in pursuance of law, report of the Geological Survey on the subject of irrigation, pp. 3–12, Washington, Government Printing Office, 1899, 8°.

The report is preceded (p. 2) by a letter of transmittal to the Secretary of the Interior, in which are contained some remarks on the importance of the irrigation surveys and the desirability of prosecuting them with dispatch, together with an estimate of appropriations needed for the continuance of the work.

Reprinted in No. 199, pp. 16–29.

193. [Preliminary report (dated Feb. 8, 1889) to the Secretary of the Interior concerning "the extent to which the diversion of the waters of the Platte and Arkansas rivers and their tributaries in Colorado for irrigation and other purposes affects the flow of the waters of those streams in the lower valleys, and especially during the growing season, and whether the title conveyed by the Government to lands fronting on said streams covers the privilege of diverting water therefrom beyond that necessary for use thereon for irrigation and mining purposes, and what action is needed to protect the rights of riparian owners along the waters of said streams in the States of Kansas and Arkansas, and what measures can be devised to increase the flow of water in those streams during such season."]

In Senate ex. doc. No. 120, 50th Congress, 2d session, Letter from the Secretary of the Interior, transmitting, in response to Senate resolution of August 29 [report on], the effect upon certain rivers in Colorado of the diversion of water for irrigation, pp. 2–6, Washington, Government Printing Office, 1889, 8°.

194. Eighth annual report of the Director of the United States Geological Survey [for the fiscal year 1886–87].

In United States Geological Survey, Eighth Annual Report, Part I, pp. iii–xix, 1–93, Washington, 1889, royal 8°. Two vols.

Deals with the two general subjects: business organization of the Survey (pp. 3–69) and work of the fiscal year (pp. 70–93). The business system is described in detail.

Separates were issued, with paper cover bearing title, but they include the reports of chiefs.

195. Bureau of Ethnology [and] United States Geological Survey [accounts of their operations].

In Smithsonian Institution, Annual Report for 1886, Part I, pp. 51–80, Washington, 1889, 8°.

196. Ninth annual report of the Director of the United States Geological Survey [for the fiscal year 1887–88].

In United States Geological Survey, Ninth Annual Report, pp. iii–xiii, 1–46, Washington, 1889, royal 8°.

Treats of: progress in topographic work, progress in geologic work, progress in paleontologic work, miscellaneous, necrology.

Separates were issued, with paper cover bearing title, but they include the reports of chiefs.

197. Bureau of Ethnology [account of its operations].

In Smithsonian Institution, Annual Report for 1887, Part I, pp. 20–27, Washington, 1889, 8°.

1890.

198. Statement of Maj. J. W. Powell, Director of the Geological Survey [in relation to irrigation in the United States].

In Hearings before Select Committee on Irrigation, House of Representatives, Fifty-first Congress, on the General Subject of Irrigation in the United States, pp. 4–5, 16–29 (February 6, 1890), pp. 1–90, 104–116 (February 27, 1890), Washington, 1890, 8°.

Two pamphlets with similar titles, the one dated February 6, consisting of 38 pp.; that of February 27, 134 pp.

Largely interlocutory. The testimony covers a wide field. "Artesian irrigation on the Great Plains," pp. 71–90.

Reprinted in No. 207.

199. Tenth annual report of the Director of the United States Geological Survey [for the fiscal year 1888–89].

In United States Geological Survey, Tenth Annual Report, Part I, pp. iii–xv, 1–80; Part II, pp. i–viii, 1–65; Washington, 1890, royal 8°. Two vols.

In Part I the subjects treated are: changes in organization, progress of topographic work, progress in geologic work, progress in paleontologic work, progress in accessory work, publications, conference on map publication, disbursements, financial statement.

Part II is a report on irrigation. Subjects: origin of the irrigation survey, preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation (being No. 192, reprinted), purpose of the survey, plan of the survey, instructions, areas surveyed, reservoir sites selected.

Separates were issued of the Director's report in Part I, accompanied by the reports of chiefs.

200. Statement of J. W. Powell, Director of the Geological Survey [in relation to irrigation and reclamation of arid lands].

In Report of the special committee of the United States Senate on the irrigation and reclamation of arid lands [Wm. M. Stewart, chairman], vol. 4, pp. 5–95, Washington, 1890, 8°.

Contains considerable statistical and tabulated material.

201. Irrigation. Statement of Maj. J. W. Powell, Director of the Geological Survey. June 4, 1890.

In 51st Congress, 1st session, House of Representatives, report No. 2407, submitted by Mr. Cannon from the Committee on Appropriations (sundry civil appropriation bill), pp. 53–75, Washington, Government Printing Office, 1890, 8°.

Largely interlocutory.

202. Irrigation and reclamation of public lands. United States Senate Committee on Appropriations, Wednesday, July 2 [–Friday, July 4], 1890. Statement of Major J. W. Powell, Director of the Geological Survey.

In 51st Congress, 1st session, Senate report No. 1466, submitted by Mr. Allison (sundry civil bill), pp. 46–109, 131–136, Washington, Government Printing Office, 1890, 8°.

Largely interlocutory.

203. Report relative to the use made of the appropriation for the irrigation survey.

In 51st Congress, 1st session, Senate ex. doc. No. 141, Letter from the Secretary of the Interior, transmitting, in response to resolution of May 26, 1890, a report [etc.], pp. 2–8, Washington, Government Printing Office, 1890, 8°.

204. Bureau of Ethnology [account of its operations].
In Smithsonian Institution, Annual Report for 1888, pp. 62–75, Washington, 1890, 8°.

205. Bureau of Ethnology [account of its operations].
In Smithsonian Institution, Annual Report for 1889, pp. 55–65, Washington, 1890, 8°.

1891.

206. Seventh annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1885–86].
In Bureau of Ethnology, Seventh Annual Report, pp. xv–xli, Washington, 1891, royal 8°.
Deals with the customary subjects.
Issued in separate form, with paper cover bearing title.

207. Eleventh annual report of the Director of the United States Geological Survey [for the fiscal year 1889–90].
In United States Geological Survey, Eleventh Annual Report, Part I, pp. iii–xv, 1–30; Part II, pp. i–xiv, 1–395; Washington, 1891, royal 8°. Two vols.
In Part I the subjects treated are the usual ones. Part II relates to the irrigation survey; it includes a statement of the Director to the House Committee on Irrigation (pp. 203–289; see title No. 198), and a catalogue of irrigation litertture (pp. 345–388).
Separates issued of the Part I portion, but they include the reports of chiefs.

208. Eighth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1886–87].
In Bureau of Ethnology, Eighth Annual Report, pp. xvii–xxxvi, Washington, 1891, royal 8°.
Deals with the customary subjects.
Issued in separate form, with paper cover bearing title.

209. Twelfth annual report of the Director of the United States Geological Survey [for the fiscal year 1890–91].
In United States Geological Survey, Twelfth Annual Report, Part I, pp. iii–xiii, 1–19, Washington, 1891, royal 8°.
Treats the usual subjects.
Separates issued, but they include the reports of chiefs.

210. Report of the Director of the Bureau of Ethnology.

In Smithsonian Institution, Annual Report for 1890, pp. 47–54, Washington, 1891, 8°.

1892.

211. Ninth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1887–88].

In Bureau of Ethnology, Ninth Annual Report, pp. xxiii–xlvi, Washington, 1892, royal 8°.

Relates to the usual subjects.

Separates issued, with paper cover bearing title.

212. Statement of Mr. John W. Powell, Director of the U. S. Geological Survey [relative to the printing and distribution of the reports of the Survey and Bureau of Ethnology].

In 52d Congress, 1st session, Senate Report No. 18 (to accompany S. 1549, providing for the public printing and binding and the distribution of public documents), pp. 220–234, Washington, Government Printing Office, 1892, 8°.

213. Thirteenth annual report of the Director of the United States Geological Survey [for the fiscal year 1891–92].

In United States Geological Survey, Thirteenth Annual Report, Part I, pp. iii–vii, 1–66, Washington, 1892, royal 8°.

Deals with the usual subjects.

Separates issued, but they include the reports of chiefs.

1893.

214. The work of the U. S. Geological Survey. By J. W. Powell, Director.

In Science for January 13, 1893, vol. 21, pp. 15–17, New York, 1893, 4°.

Treats of organization, current work, and future work.

Read before the Geological Society of America at Ottawa, December 30, 1892.

215. Tenth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1888–89].

In Bureau of Ethnology, Tenth Annual Report, pp. ix–xxx, Washington, 1893, royal 8°.

Relates to the usual subjects.

Separates issued, with paper cover bearing title.

216. Report of the Director of the Bureau of Ethnology for the year ending June 30, 1891.

In Smithsonian Institution, Annual Report for 1891, pp. 29–37, Washington, 1893, 8°.

217. Fourteenth annual report of the Director of the United States Geological Survey [for the fiscal year 1892–93].

In United States Geological Survey, Fourteenth Annual Report, Part I, pp. 3–165, Washington, 1893, royal 8°.

Treats of: plan of work for the year, organization and progress of the year's work, necrology, general work in taxonomy, general summary of paleontologic work, general summary of work in terrestrial physics.

Separates issued, but they include the reports of chiefs.

218. Report of the Director of the Bureau of Ethnology for the year ending June 30, 1892.

In Smithsonian Institution, Annual Report for 1892, pp. 49–58, Washington, 1893, 8°.

219. Eleventh annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1889–90].

In Bureau of Ethnology, Eleventh Annual Report, pp. xxiii–xlvii, Washington, 1894, royal 8°.

Treats the customary subjects.

Issued separately, with paper cover bearing title.

220. Twelfth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1890–91].

In Bureau of Ethnology, Twelfth Annual Report, pp. xxi–xlviii, Washington, 1894, royal 8°.

Treats the usual subjects.

Issued separately, with paper cover bearing title.

221. Report of the Director of the Bureau of Ethnology for the year ending June 30, 1893.

In Smithsonian Institution, Annual Report for 1893, pp. 38–44, Washington, 1894, 8°.

1895.

222. [Fifteenth annual] report of the Director [of the United States Geological Survey] for the fiscal year ending June 30, 1894.

In United States Geological Survey, Fifteenth Annual Report, pp. 3–108, Washington, 1895, royal 8°.

Deals with the usual subjects. On page 7 Major Powell, retiring from the Directorship, addresses a few words of farewell to his collaborators in the Geological Survey.

Separates issued, but they contain also the reports of chiefs.

1896.

223. Thirteenth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1891–92].

In Bureau of Ethnology, Thirteenth Annual Report, pp. xxi–lix, Washington, 1896, royal 8°.

Follows the usual lines of these reports.

Separates were issued, with paper cover bearing title.

224. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1894.

In Smithsonian Institution, Annual Report for 1894, pp. 44–57, Washington, 1896, 8°.

225. Fourteenth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1892–93].

In Bureau of Ethnology, Fourteenth Annual Report, Part I, pp. xxvii–lxi, Washington, 1896, royal 8°.

Treats the usual subjects.

Separates were issued, with paper cover bearing title.

226. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1895.

In Smithsonian Institution, Annual Report for 1895, pp. 42–54, Washington, 1896, 8°.

1897.

227. Fifteenth annual report [of the Director] of the Bureau of Ethnology [for the fiscal year 1893–94].

In Bureau of Ethnology, Fifteenth Annual Report, pp. xvii–cxxi, Washington, 1897, royal 8°.

Principal subheadings are: introduction, monthly reports, summary report, financial statement, characterization of accompanying papers, on regimentation.

"Regimentation in sociology is the analog of organization in biology."

228. Sixteenth annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1894–95].

In Bureau of American Ethnology, Sixteenth Annual Report, pp. xv–xcix, Washington, 1897, royal 8°.

Treats the usual subjects.

Separates were issued, with paper cover bearing title.

1898.

229. Seventeenth annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1895–96].

In Bureau of American Ethnology, Seventeenth Annual Report, Part I, pp. xxvii–lxxiii, Washington, 1898, royal 8°.

Chief headings are: introduction, exploration, archeology, descriptive ethnology, sociology, linguistics, mythology, psychology, bibliography, publication, miscellaneous work, necrology, financial statement, characterization of accompanying papers.

Separates were issued, with paper cover bearing title.

230. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1896.

In Smithsonian Institution, Annual Report for 1896, pp. 32–45, Washington, 1898, 8°.

231. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1897.

In Smithsonian Institution, Annual Report for 1897, pp. 33–45, Washington, 1898, 8°.

1899.

232. Eighteenth annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1896–97].

In Bureau of American Ethnology, Eighteenth Annual Report, Part I, pp. xxv–lvii, Washington, 1899, royal 8°.

Treats the usual subjects.

Separates were issued, with paper cover bearing title.

233. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1898.

In Smithsonian Institution, Annual Report for 1898, pp. 36–48, Washington, 1899, 8°.

1900.

234. Nineteenth annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1897–98].

In Bureau of American Ethnology, Nineteenth Annual Report, Part I, pp. xi–xcii, Washington, 1900, royal 8°.

Treats the usual subjects and, in addition, "Esthetology, or the science of activities designed to give pleasure," pp. lv–xcii. (See No. 144.)

Issued in separate form, with paper cover bearing title.

1901.

235. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1899.

In Smithsonian Institution, Annual Report for 1899, pp. 34–42, Washington, 1901, 8°.

236. Report of the Director of the Bureau of American Ethnology for the year ending June 30, 1900.

In Smithsonian Institution, Annual Report for 1900, pp. 59–72, Washington, 1901, 8°.

1903.

237. Twentieth annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1898–99].

In Bureau of American Ethnology, Twentieth Annual Report, pp. ——, Washington, 190–, royal 8°. Not yet published.

Treats the usual subjects, and contains also the four papers "Technology," "Sociology," "Philology," and "Sophiology" (see titles Nos. 146, 147, 150, and 151).

238. Twenty-first annual report [of the Director] of the Bureau of American Ethnology [for the fiscal year 1899–1900].

In Bureau of American Ethnology, Twenty-first Annual Report, pp. ——, Washington, 190– royal 8°. Not yet published.

MISCELLANEOUS.

1880.

239. Biographical notice of Archibald Robertson Marvine. By J. W. Powell. (Read June 3, 1876.)

In Philosophical Society of Washington, Bulletin, vol. 2, appendix, pp. 53–60, Washington, 1875–1880, 8°.

This Bulletin also forms a part of Smithsonian Miscellaneous Collections, vol. 20.

The biographical notice was issued separately, also: cover bearing half-title, pp. i–viii (53–60 at bottom), 8°.

1881.

240. Sketch of Lewis H. Morgan, president of the American Association for the Advancement of Science. By J. W. Powell.

In Popular Science Monthly for November, 1880, vol. 18, pp. 114–121, New York, 1881, 8°.

1884.

241. Address by Hon. John W. Powell, LL.D., delivered at the inauguration of the Corcoran School of Science and Arts, in the Columbian University, Washington, D.C., October 1, 1884.

Washington, D.C. Gibson Brothers, printers. 1884.

Cover and 20 pp., 8°.

A characterization and comparison of ancient and modern civilizations, with conclusions based thereon concerning modern education.

1885.

242. The administration of the scientific work of the general government.

In Science for January 16, 1885, vol. 5, pp. 51–55, Cambridge, Mass., 1885, 4°.

An extract from No. 183.

243. The larger import of scientific education. By J. W. Powell, LL.D.

In Popular Science Monthly for February, 1885, vol. 26, pp. 452–456, New York, 1885, 8°.

1888.

244. The personal characteristics of Professor Baird. By Mr. J. W. Powell, president of the Anthropological Society.

In Proceedings at a meeting commemorative of the life and scientific work of Spencer Fullerton Baird, held January 11, 1888, under the joint auspices of the Anthropological, Biological, and Philosophical societies of Washington, pp. 31–37, Washington, D. C., Judd & Detweiler, 1888, 8°.

Professor Baird's characteristics are noticed principally in three respects: as an organizer of the agencies of research, as a man of affairs, and as director of the work of research.

Appeared also as follows:

The personal characteristics of Professor Baird. By Mr. J. W. Powell, president of the Anthropological Society.

In Philosophical Society of Washington, Bulletin, vol. 10, pp. 71–77, Washington, 1888, 8°.

This bulletin forms a part of Smithsonian Miscellaneous Collections, vol. 33.

Issued separately as follows:

Eulogy of Professor Baird. An address delivered at a meeting held Jauuary 11, 1888, under the joint auspices of the Anthropological, Biological, and Philosophical societies of Washington. By J. W. Powell.

[Washington, D. C.: Judd & Detweiler. 1888.]

Cover and 7 pp., 8°.

The address appears also in the Smithsonian Annual Report for 1888, Part I, pp. 739–744, and in the following separate from that report:

— 762 — Biographical memoirs of Spencer Fullerton Baird. From the Smithsonian Report for 1888.

Washington: Government Printing Office. 1890.

Cover, title, and pp. 703–744, 8°.

Powell (J. W.), the personal characteristics of Professor Baird, pp. 739–744.

Published also as follows:

Address of Major Powell in memory of Professor Baird.

In Science (supplement) for January 13, 1888, vol. 11, pp. 25–26, New York, 1888, 4°.

1889.

245. The lesson of Conemaugh. By Major J. W. Powell, Director of the United States Geological Survey.

In North American Review for August, 1889, vol. 149, pp. 150–156, New York, 1889, 8°.

1890.

246. Remarks of Major J. W. Powell, Director of the U. S. Geological Survey [on a proposed world's exposition at Washington in 1892].

In Three Americas Exposition, Arguments before the quadri-centennial committee of the United States Senate, in support of Senate bills Nos. 1839 and 1135, each entitled: "A bill to provide for a three Americas and world's exposition at the National Capital in 1892," pp. 21–27, Washington, D. C., January 10, 1890, 8°.

1890–1891.

247. Dr. Cook as a geologist. By Major J. W. Powell, Ph.D., LL.D.

In Targum (published by the students of Rutgers College), vol. 10, pp. 207–208, New Brunswick, N. J., 1890, 4°.

Delivered at the "Memorial services of George Hammell Cook, Ph.D., LL.D., vice president of Rutgers College," held at New Brunswick, N. J., June 17, 1890.

Republished as follows:

Dr. Cook as a geologist. By Maj. J. W. Powell, Ph.D., LL.D.

In Addresses commemorative of George Hammell Cook, Ph.D., LL.D., professor of geology and agriculture in Rutgers College [etc.], pp. 20–27, Newark, N. J., Advertiser Printing House, 1891, 8°.

1891–1892.

248. National agencies for scientific research. By Major J. W. Powell, Ph.D., LL.D. Director of the United States Geological Survey.

In Chautauquan for October, November, and December, 1891, and January, February, and March, 1892, vol. 14, pp. 37–42, 160–165, 291–297, 422–425, 545–549, 668–673, Meadville, Pa. [1892], 8°.

I. The Smithsonian Institution, pp. 37–42 (No. for October, 1891).

II. The Department of Agriculture, pp. 160–165 (No. for November, 1891).

III. The Weather Bureau, pp. 291–297 (No. for December, 1891).

IV. The Coast Survey, pp. 422–425, 545–549 (Nos. for January and February, 1892).

V. The Geological Survey, pp. 668–673 (No. for March, 1892).

1893.

249. Simplified spelling.

In American Anthropologist for April, 1893, vol. 6, pp. 193–195, Washington, 1893, 8°.

One of twelve addresses — a symposium.

Some separates were issued of the whole symposium (pp. 137–206), without cover, and without change except the addition at the top of the first page (137) of the line "[From the American Anthropologist for April, 1893.]"

1896.

250. James Dwight Dana.

In Science for February 7, 1896, new series, vol. 3, pp. 181–185, New York, 4°.

A memorial address before the scientific societies of Washington, given on January 14, 1896.

1898.

251. Remarks made, on behalf of the journal *Science*, at the Gardiner Greene Hubbard memorial meeting held in Washington on January 21, 1898, late president of the National Geographic Society.

In National Geographic Magazine for February, 1898, vol. 9, pp. 59–63, Washington, 8°.

PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

Vol. V, pp. 189–229. [Plates ii–xx.] September 12, 1903.

PAPERS FROM THE HOPKINS STANFORD GALAPAGOS EXPEDITION, 1898–1899.

XV.

NEW FISHES.

By Edmund Heller and Robert Evans Snodgrass.

INTRODUCTION.

The twenty-three new species here recorded are described from the material obtained by the authors in 1898 and 1899 at the Galapagos Archipelago, Cocos Island and in the neighboring waters. The proportional measurements given are percentages of the length to the end of the vertebræ, except where otherwise stated. The writers are indebted to Dr. David Starr Jordan and to Dr. Charles Henry Gilbert, of Stanford University, for suggestions and assistance while working on the collection.

Evolantia, gen. nov.

Characters. — Pectorals about one third of total length; ventrals very short, outer lobe three and three fourths in head, a little less than four in pectoral, inner lobe two in head, insertion midway between posterior border of opercle and base of caudal; anal fin but little shorter than dorsal.

A single species known, *E. micropterus* (Cuvier & Valenciennes).

According to the disposition by Jordan & Evermann[1] of the flying fishes with the ventrals inserted behind the middle of the body into

[1] Fishes N. & M. A., III, Addenda, pp. 2835, 2836.

two genera, *Exonautes* and *Cypsilurus*, each with large ventrals, this species must be placed by itself in a third genus, for it differs from *Exonautes* and *Cypsilurus*, as thus defined, in having short ventrals and pectorals, but agrees with *Exonautes* in the length of the anal. It is probably allied to *Exonautes* rather than to *Exocœtus*, which has small ventrals, on account of the posterior position of these fins, the ventrals being anterior in *Exocœtus*. *Evolantia*, hence, represents an *Exonautes* with unspecialized ventrals and with but slightly elongated pectorals.

Specimens were secured in latitude 4° N., longitude 90° W.

SPHYRÆNA IDIASTES sp. nov.

Pl. II.

Type. — Cat. No. 12331, Leland Stanford Jr. University Museum. Seymour Island.

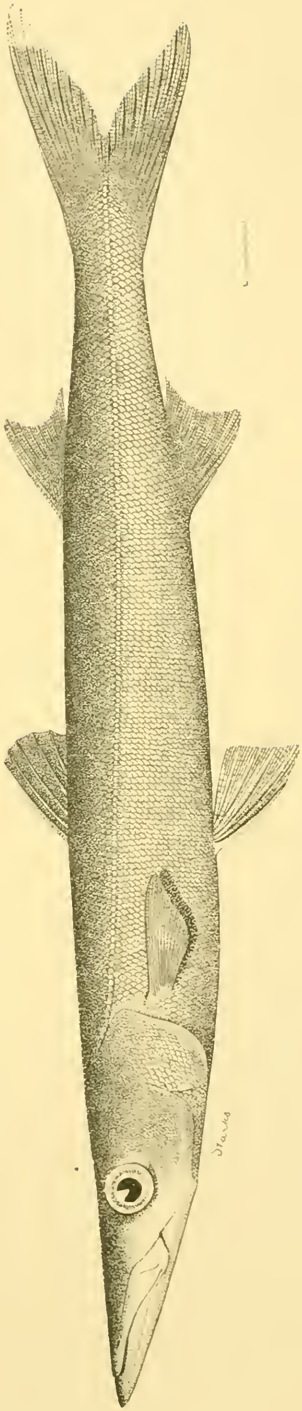
Diagnosis. — Differs from *S. argentea*, its closest American ally, in the posterior insertion of the ventrals, the greater length of the head, the wider interval between the maxillary and eye and in the possession of smaller scales. It is apparently most closely related to *S. helleri*[1] of the Hawaiian Islands from which species it differs in the scale formulæ, in the greater number of vertical rows of scales on the opercle, in the extension of the scaled area beyond the posterior border of the eye and in the longer pectorals.

Description of the Type. — Length 480 mm.; head 3; depth 8; eye 7; D. V, 10; A. 10; scales 20–145–12.

General shape fusiform, dorsal and ventral outlines symmetrical; head slender, acutely conical. Maxillary not reaching anterior border of orbit, separated by a space a little greater than diameter of eye; suborbital one half of head; posterior angle of opercle obtuse; exserted portion of mandible slightly greater in length than one half diameter of eye. Scales on suborbital, extending forward to below center of pupil; top of head, sides of snout and a crescent-shaped area behind and below eye naked.

Front of each jaw toothless; a series of small, flat, triangular teeth along sides of both jaws; those on mandible larger and fewer. Internal horizontal plate of each premaxillary with three large, flat, elongate teeth inclined backward; in line with each of these series are a series of six similar, large, palatine teeth directed downward and inward followed by a long series of minute teeth. Anterior portion of mandible with two large, triangular teeth directed backward.

[1] *Sphyræna helleri* Jenkins, Bull. U. S. Fish Comm., p. 387, 1899.



Sphyræna idiastes

A.HOEN & CO. BALTIMORE

First dorsal spine longest, four in head; posterior spines decreasing regularly in length to last which is equal to diameter of eye; spines depressible in a groove. Second ray of soft dorsal longest, exceeding slightly the first ray, three and one third in length of head; posterior rays decreasing regularly in length to ninth which is three and one half in length of first; last ray longer, two and one half in first. Caudal fin deeply forked, lobes equal. Pectorals small, about three in head, slightly exceeding the ventrals, upper rays longest. Anal similar to soft dorsal in shape but lower, first ray three and three fourths in head.

A young specimen, 50 mm. long — presumably belonging to this species — taken from the surf near Tagus Cove, Albemarle, has a series of eight wide black median dorsal spots. The first is the largest and is situated on the head posterior to the eyes, the second is fused in the median line with the third, and the last is situated on the base of the caudal peduncle. On each side is a black longitudinal line, best marked posteriorly. At the base of the anal is a large brown spot and there is a similar spot on the middle of the caudal peduncle, while at the base of the caudal fin is a smaller one. The snout and tip of the lower jaw are dusky. The rest of the body is pale. Another specimen, 40 mm. long, has the same characters except that the second dorsal spot is narrower and not fused with the third. A third specimen 97 mm. long has a faint indication of this color pattern, there being a fairly well marked granular lateral stripe and obscure traces of the dorsal spots.

MEASUREMENTS OF *Sphyræna idiastes*.

Catalogue No. Leland Stanford Jr. University Museum.	(Type). 12331.	12321.
Length in mm	480	493
Head	33	33
Depth	13	12
Pectoral	11	10
Ventral	10	9
Depth of caudal peduncle	6	6
Eye: Head	14	14
Maxillary: Head	32	36
Exsertion of mandible: Head	8	8
Snout: Head	41	40
Interorbital: Head	15	16
Suborbital: Head	7	7
Dorsal Spines	V	V
Dorsal Rays	10	10
Anal Rays	10	10
Scales in lateral line	145	143
Scales, transverse	20–12	18–12

APOGON ATRADORSATUS sp. nov.

Pl. III.

Type. — Cat. No. 6357, Leland Stanford Jr. University Museum. Charles Island.

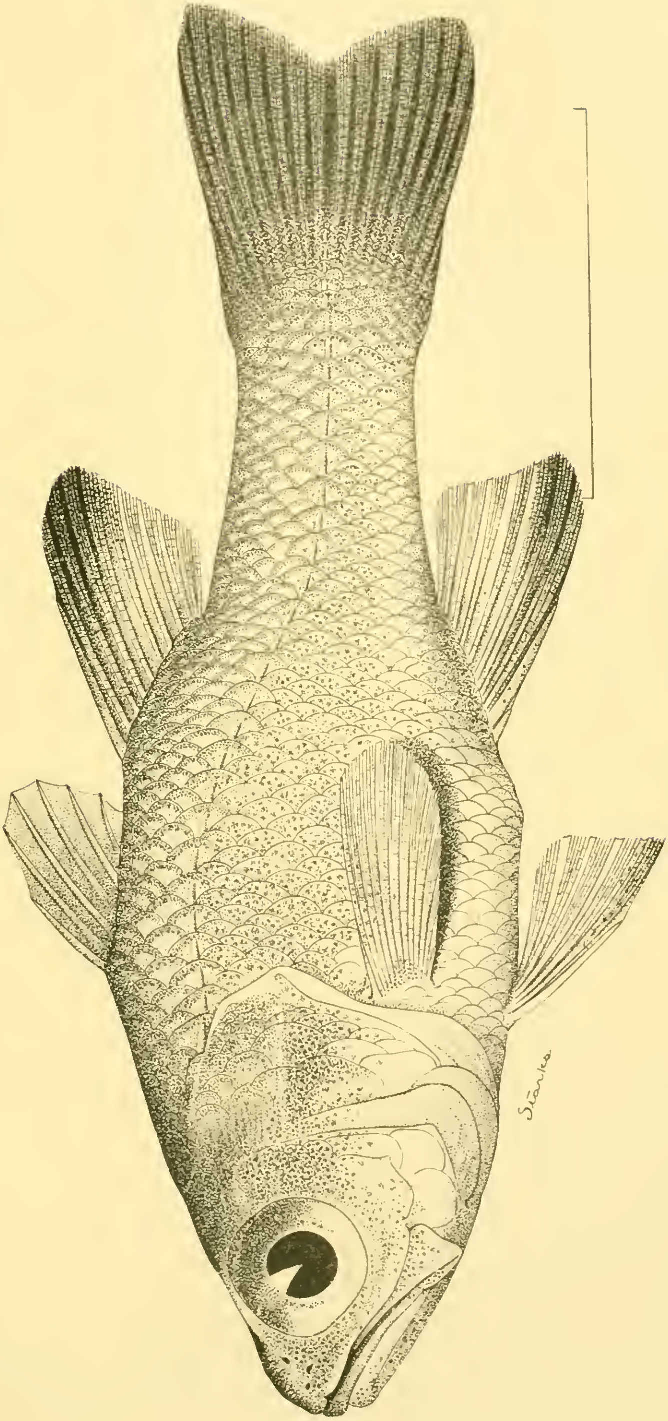
Diagnosis. — Almost identical with *Apogon atricaudus* of the Revillagigedo Archipelago, differing from it in having the distal half of the second dorsal black.

We have examined numerous specimens of *Apogon atricaudus* in the Stanford University collection and not one of them shows any trace of black on the second dorsal. Our specimens, preserved in the same manner as the others, invariably have the black on this fin. If the Revillagigedo specimens had in life any black on the second dorsal fin it has, in all cases, faded from it, but not from the first dorsal nor from the caudal. In many Galapagos specimens the tail appears to be a little more deeply forked than in the Revillagigedo specimens, but it is not constantly so.

Description of the Type. — Head two and two thirds; depth three; eye three; D. VI–I, 9; A. II, 8; scales minutely ctenoid, 3–25–11. Maxillary reaching a little back of posterior margin of pupil; pectorals reaching base of anal; ventrals reaching posterior margin of anus.

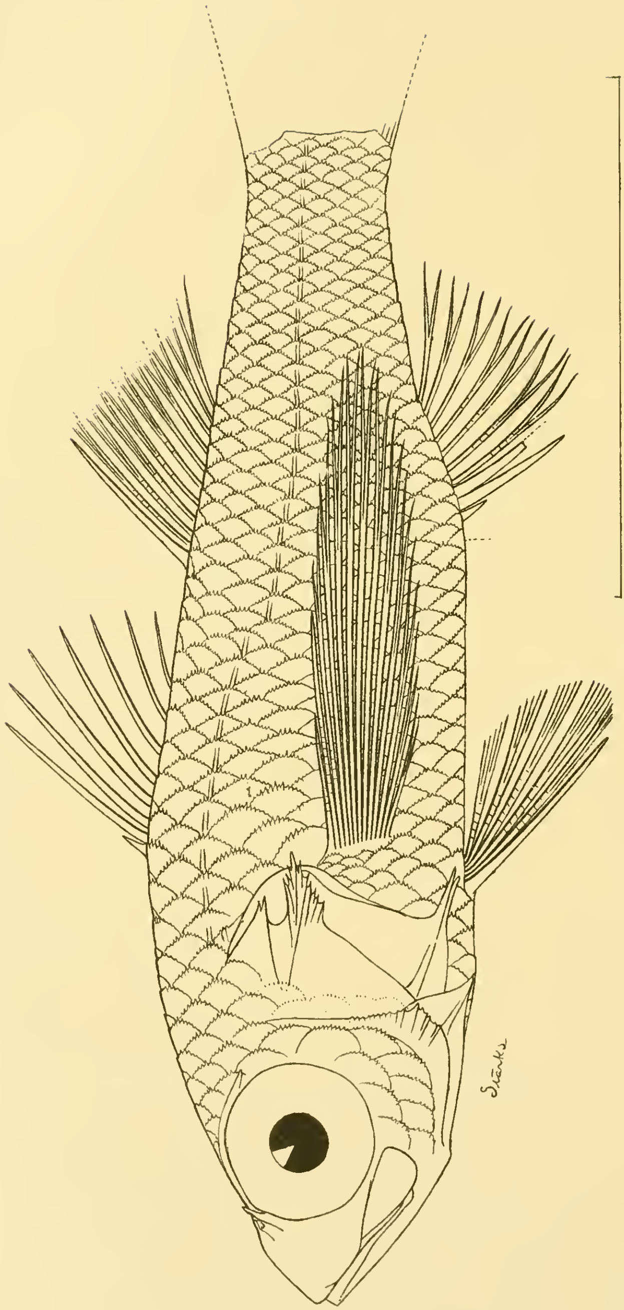
Snout blunt; profile of head straight, gently inclined from snout to front of dorsal, slightly concave from this point to front of second dorsal, descending then to base of caudal peduncle, where it forms an abrupt angle with the peduncle; ventral profile with about same convexity as dorsal, but outline from front of anal to base of caudal fin evenly and roundly concave. Second dorsal higher than first; first dorsal spine short (variable in length, in largest specimens about equal to interorbital space, in younger ones shorter); second and third spines longest, two and one half in head; succeeding spines rapidly shorter, so that posterior border of fin is receding; seventh spine attached to second dorsal, as long as second and third; second and third soft rays of dorsal longest, one half longer than last spine; posterior rays very short so that dorsal margin of fin posteriorly turns downward and forward; soft anal similar to soft dorsal; tail emarginate (the depth of emargination greater in young specimens).

Coloration in Alcohol. — Brownish, darker above, minutely punctate with black specks; caudal and first dorsal dusky, second dorsal and anal pale basally, dusky terminally. In life the color was bright red, paler below, with the distal parts of the vertical fins black.



Apogon atradorsatus

A. HOEN & CO. BALTIMORE



Galeagra pammelas

The collection contains a large number of specimens of this species from Cocos Island, and from Seymour, Chatham, Narboro, Albemarle (Tagus Cove) Tower, James, Hood, Duncan, Barrington and Charles Islands of the Galapagos Archipelago.

Galeagra gen. nov.

Characters. — Head similar in shape to that of *Apogon* but the body somewhat more elongate. Subopercle, interopercle and opercle with their angles armed with more or less prominent spines; preopercle with a double edge, the posterior edge serrated. Scales large, ctenoid, thirty three in the lateral line; lateral line little curved, interrupted; pectoral greatly elongate; dorsal fins two, the spines VIII–I; anal spines III; soft parts of both dorsal and anal short; teeth small, present in both jaws, and in a V-shaped patch on the vomer; gills four, with a slit behind the last; gill-rakers long; branchiostegals six.

Affinities somewhat doubtful. The single specimen on which the genus is based is evidently a deep-sea form.

GALEAGRA PAMMELAS sp. nov.

Pl. IV.

Type. —Cat. No. 6355, Leland Stanford Jr. University Museum. Wenman Island.

Diagnosis. — Subopercle armed with a large spine at the angle; interopercle with a smaller spine; opercle with several small spines at angle and with a deep notch above angle; preopercle with a double edge, the anterior short, the posterior serrated; scales large, 2–33–7, serrated; lateral line not following outline of back, broken. D. VIII–I, 10; A. III, 7; maxillary short, extending to the vertical from middle of pupil; pectorals produced.

Description of the Type. — Head two and seven ninths in length; depth three and five sixths; eye two and two sevenths in head, maxillary two and two ninths; interorbital four and one ninth. D. VIII–I, 10; A. III, 7; scales 2–33–7, pores 33.

Body little elevated, vertical profile elliptical, with the greatest depth at front of dorsal fin; body more or less compressed; head flat above the oblique profile; snout obtusely pointed, equaling the interorbital width in length; mouth rather small, oblique, with equal jaws; maxillary short, extending to vertical from middle of pupil, lower edge smooth; both jaws armed with a single series of small teeth; a V-shaped patch of eight or nine slightly enlarged teeth on vomer; palatines apparently toothless; head spiny, with small pre- and postocular spines on the supraocular margin; preopercle with a double edge, the anterior short and soon obsolete dorsally, the posterior rounded at angle, and armed with slender serrations on angle and on posterior edge; subopercle with a stout spine at angle, bifid at tip, upper spine longest, slightly more than one half the interorbital width in length; interopercle with a smaller, stouter spine at angle; opercle smooth along lower edge, the angle armed with about twelve small spines, the one at the angle considerably enlarged, a deep rounded notch above angle with two small spines above it. Gills four, a slit behind last; pseudo-branchiæ well developed. Gill-rakers long, more than one third of eye in length; fourteen below the angle. Brachiostegal rays six.

Scales large, thirty-three in lateral line, armed with moderately long, slender serrations; head scaled on cheeks and on occiput to between orbits; entire body scaled, leaving only fin membranes naked. Lateral line begins above opercle and extends in a slight curve to between the dorsals, then goes obliquely downwards for a short distance, and then horizontally to caudal peduncle; broken between dorsals by a slight interval. (Some of the posterior scales of the lateral line are missing.)

Dorsal fins two, separated in front of last dorsal spine by an interval equal to diameter of eye. Spinous part high, rounded; third spine highest, slightly greater than one half the length of head; first spine very short; posterior spines slender. Soft dorsal joined to last dorsal spine, outline of the fin lunate, posterior rays somewhat produced and filamentous, about equaling anterior ones in length. Anal fin beginning behind origin of soft dorsal, spinous part much lower than spinous dorsal; first spine very short, second longest but evidently shorter than third, which is stouter but broken at tip. Soft anal similar to soft dorsal, but scarcely lunate. Pectoral fin long and ribbon-shaped, rays filamentous at tip, reaching beyond posterior border of anal fin; rays thirteen. Ventrals pointed, spine nearly equaling the filaments, rays I, 5. The caudal fin is missing, only a few of the basal rays remain on the ventral side.

Coloration in Life.—Black with metallic-green iridescence; snout and lower jaw somewhat paler; fins dusky.

MEASUREMENTS OF THE TYPE OF *Galeagra pammelas*.

Length in mm	58
Head	36
Depth	26
Eye	13
Snout	8
Interorbital width	8
Maxillary	14
Height of spinous dorsal	18
Height of spinous anal	11
Height of soft dorsal	12
Height of soft anal	12
Pectoral	42
Ventral	17
Depth of caudal peduncle	12

CORVULA EURYMESOPS sp. nov.

Type. — Cat. No. 6361, Leland Stanford Jr. University Museum. Charles Island.

Diagnosis. — Closely allied to *Corvula macrops* Steindachner, from Mazatlan and Panama. It differs most conspicuously from this species in being much more slender; in having a greater number of dorsal spines—thirteen instead of twelve; in having the tip of the lower jaw slightly included (in *C. macrops* it reaches as far forward as the tip of the snout); in having the interorbital space wider; and in having a longer maxillary.

Description of the Type. — Body slender and elongate, snout blunt, lower jaw included; profile from tip of snout to nape about straight (very slightly concave), slightly rounded from here to front of spinous dorsal, straight and horizontal to front of soft dorsal, evenly descending from here to caudal peduncle. Ventral profile about same as dorsal, straight and horizontal from ventrals to anal.

Mouth oblique, at an angle of 45°. Maxillary a little greater than one half of head, about equal to second anal spine. Eye four in head. Anterior nostril oval, the posterior the larger. Angle of preopercle rounded, ascending limb inclined somewhat forward, space between its upper end and eye a little less than eye. Fifteen gill-rakers on ceratobranchial, upper ones long and slender, decreasing gradually to the lowest. Teeth all small, in a single series in lower jaw; in upper jaw a band of small teeth, the outer ones enlarged.

Fourth and fifth dorsal spines longest, about two and one half in head; first very small, almost rudimentary; second a little longer than half the length of the third; third only a little shorter than the fourth; sixth to tenth rapidly decreasing in size so that tip of tenth projects but little back of tip of fifth in elevated fin; in closed fin fifth spine reaches beyond ninth; eleventh spine shortest; twelfth and thirteenth successively a little longer, apparently a part of the soft dorsal. Rays of soft dorsal abruptly longer than the last dorsal spines, the fourth and fifth longest, equal to the sixth spine; fin decreases slightly in height posteriorly, last ray one half of fifth. Depth of caudal peduncle a little less than one third of head; caudal fin gently rounded, middle rays two in head. First anal spines short; second slightly longer than maxillary, not specially thickened; first and second soft rays of anal longer than second spine; distal border of elevated fin perpendicular; last ray less than one half of first in length. Ventrals and pectorals same length, equal to length of head behind eye. Distance between insertion of ventrals and first anal spine one third greater than depth of body.

Entire body scaled except jaws and region between rami of lower mandible. Soft dorsal and anal with scaly sheaths along their bases. Scales on snout minute. Lateral line straight anteriorly, over tip of pectoral bent somewhat downward, from here to caudal peduncle slightly convex downward; beyond this straight, continuous to edge of caudal fin. Snout with a large slit-like pore on each side, about four very small pores above and below each of these. Three pores at symphysis of lower jaw.

Coloration in Life. — Above uniform dark brown, below paler silvery-brown; center of each scale on sides of body dusky-brown, forming conspicuous narrow, dark longitudinal stripes; stripes below lateral line undulatingly horizontal, wider than those above, the upper ones cut off at middle of body by deflexure of lateral line; stripes above lateral line anteriorly running backward and upward, posteriorly horizontal, extending to end of caudal peduncle; fins plain brown.

Taken at Charles and Seymour Islands.

The following table gives comparative measurements of *Corvula eurymesops*, and of one specimen of *C. macrops* in the Stanford University collection from Mazatlan.

MEASUREMENTS OF *Corvula eurymesops* AND *Corvula macrops*.

Catalogue No. Leland Stanford Jr. University Museum.	*Corvula eurymesops.*				*C. macrops.*
	12305.	(Type) 6361.	12306.	12307.	
Length in mm	156	148	137	131	161
Depth	31	29	27	28	35
Head	31	32	32	32	30
Pectoral	22	22	22	23	22
Ventral	23	23	23	23	22
Maxillary: Head	53	52	48	51	49
Eye: Head	27	26	26	28	31
Interorbital: Head	29	29	27	27	25
Dorsal Spines	XIV	XIII	XIII	XIII	XII
Second Dorsal Rays	24	23	24	24	25
Second Anal Rays	9	9	8	9	9
Scales on Lateral Line	46	50	46	47	48

SCIÆNA PERISSA sp. nov.

Type.— Cat. No. 6360 Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.

Diagnosis.—Distinguishable from any other member of the genus by the weakly serrated preopercle, enlarged anal spine and the small number of spines in the dorsal.

Description of the Type.—Length 183 mm.; depth two and three fifths; head about three; upper profile of body strongly convex, greatest depth at front of soft dorsal; ventral profile much less convex, evenly rounded; snout blunt, rounded; lower jaw included, symphysis nearer vertical from anterior nostril than from point midway between anterior nostril and snout. Tip of snout slightly lower than anterior nostril, strongly receding to mouth; mouth nearly horizontal; profile from snout to nape almost straight. Snout below tip with eight pores, a large slit-like pore on each side, three just above mouth, three very small ones just above these; symphysis with five pores, one small, slit-like, median one, two on each side, of which the posterior is the larger. Teeth small, in bands along sides of jaws, the outer ones, especially in upper jaw, enlarged; bands in lower jaw wide in front, tapering posteriorly; no vomerine teeth. Anterior nostril lower and smaller than posterior. Suborbital a little narrower than vertical diameter of eye. Ascending limb of preopercle very weakly serrated, inclined forward; space between its upper end and orbit equal to vertical diameter of eye. Opercle with wide membranous flap on posterior border above angle.

D. X, 33. First dorsal spine very short; second abruptly much longer; the fourth longest, two and one half in head; posterior border of fin almost vertical, last spine longer than ninth. Second dorsal fin low in front, gradually rising toward posterior end where border curves abruptly downward; the longest ray, the twenty-sixth, three in head, about equal to second dorsal spine. Anal short, II, 8; second spine two and one half in head; first and second soft rays longest, two in head, longer than fourth dorsal spine. Depth of caudal peduncle a little less than three in head. Caudal fin gently rounded, middle rays almost two in head. Upper rays of pectoral longest, one and two fifths in head.

Snout, subopercle, jaws and chin bare, rest of body covered with small ctenoid scales; small, irregularly arranged scales along lateral line.

Specimens of this species were secured at Tagus Cove and Elizabeth Bay, Albemarle Island and at Seymour Island.

Coloration in Life. — Above dusky-brown; belly grayish; lips flesh-color; fins dusky; iris golden-brown.

MEASUREMENTS OF *Sciæna perissa.*

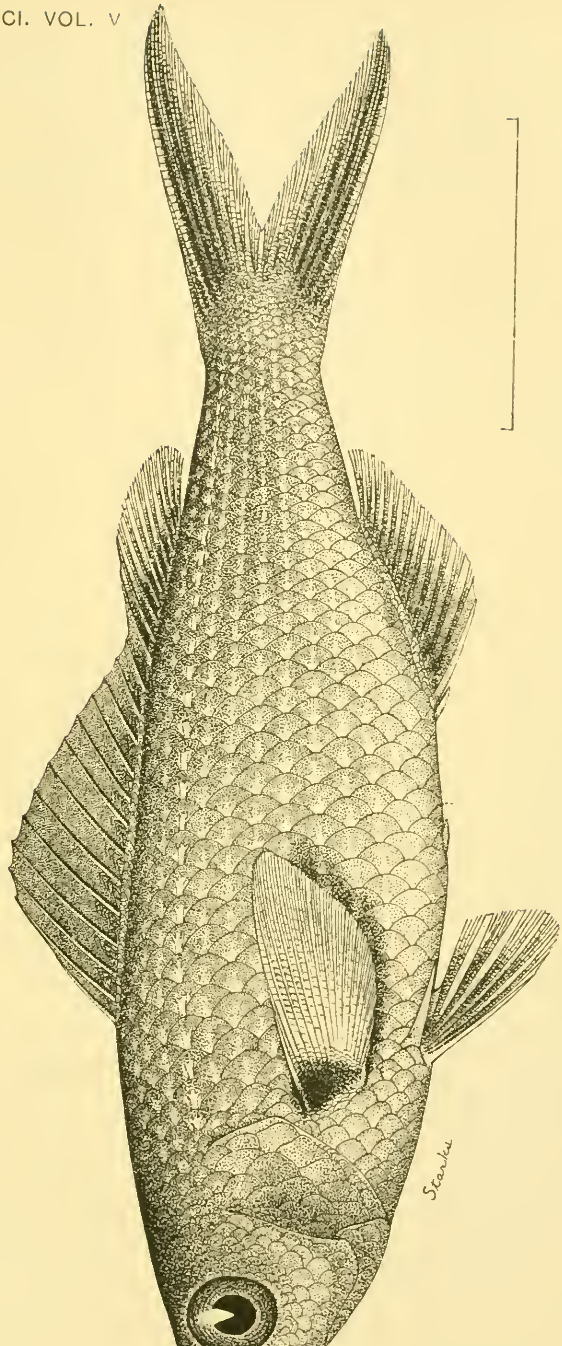
Catalogue No. Leland Stanford Jr. University Museum.	12301.		(Type) 6360.	12302.	12303.	12304.
Length in mm	230	187	183	178	167	147
Depth	39	36	39	38	38	38
Head	37	34	35	36	35	37
Pectoral : Head	67	59	62	67	65	58
Ventral : Head	54	58	64	59	61	55
Snout : Head	28	24	24	22	27	25
Eye : Head	20	26	24	25	23	24
Dorsal Spines	X	X	X	X	IX	X
Second Dorsal Rays	33	33	33	31	32	31
Second Anal Rays	7	8	8	8	8	7

AZURINA EUPALAMA sp. nov.

Pl. V.

Type. — Cat. No. 6352, Leland Stanford Jr. University Museum. Hood Island.

Diagnosis. — Differs from *A. hirundo* in being more slender, in having the lateral line more nearly straight, the tip of the snout blunter, the interorbital space wider, the nape less elevated, the ventral profile of the body more convex, it being more convex than the upper, and in having the color olive and gray instead of blue.



Azurina eupalama

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Description of the Type. — Length 92 mm., depth three and four sevenths; head three and four sevenths; pectoral four and one third; ventral five and four fifths; D. XIII, 11; A. II, 12.

Upper profile of head and body very gently and evenly curved from tip of snout to a little in front of base of caudal. Posterior end of caudal peduncle a little deeper than median part. Ventral profile of head and body also evenly curved, but more convex than the dorsal. Mouth oblique, on level with middle of caudal peduncle. Eye irregularly elliptical, longest diameter vertical. Preorbital narrow, least width about two and one half in vertical diameter of eye. Interorbital space equal to vertical diameter of eye. Upper limb of posterior margin of preopercle almost vertical, angle prominent, whole margin entire.

First dorsal spine short, considerably shorter than the others, equaling horizontal diameter of eye; third, fourth and fifth spines longest, two in head; second a little shorter than the third; spines back of fifth gradually decreasing in length; the last shorter than the first. Profile of soft dorsal rounded, median rays longest, about three fourths of longest spine. Anal longer than soft dorsal, not symmetrical with it, anterior rays longest, a little longer than second anal spine which is equal to length of longest soft dorsal ray; first anal spine very short. Caudal deeply forked, upper lobe very slightly longer than lower, outer edge of each gently convex posteriorly. Pectoral equal to greatest depth of body below lateral line, upper rays longest. Ventral one and three fourths in head, tip not prolonged into a filament.

All parts except lips, fins, and space about nostrils scaled. Scales of body large, in thirty-two oblique series. Lateral line continuous, extending entire length of body, very gently convex dorsally.

Coloration in Alcohol. — Brown, paler beneath, with longitudinal pale area on middle of each scale forming indistinct, pale, longitudinal stripes along the sides of body; a prominent black area on axil, covering also both sides of the base of the pectoral; caudal dusky with both margins of the lobes pale; soft dorsal and anal dusky along bases; otherwise fins plain brown like body.

Coloration in Life. — Above dusky olive with bluish iridescence, sides lighter dusky-gray, belly silvery, snout pure dusky; dorsal dusky, base of soft dorsal black; axil and base of pectoral black; pectorals, ventrals and anal pale; caudal pale with a dusky oblique streak through each lobe.

Variations. — The eight specimens secured present scarcely any departures from the characters of the *type* as described above.

Taken at Charles and Hood Islands.

MEASUREMENTS OF *Azurina eupalama*.

Catalogue No. Leland Stanford Jr. University Museum.	(Type) 6352.		12299.	12300.	
Length in mm	92	86	85	83	80
Depth	28	29	28	26	29
Head	28	28	29	29	30
Pectoral	23	23	24	22	24
Ventral	17	18	18	18	18
Vertical Diameter of Eye: Head	30	30	29	30	33
Interorbital: Head	33	32	30	30	33
Preorbital: Head	10	9	10	10	10
Dorsal Spines	XIII	XIII	XIII	XIII	XIII
Second Dorsal Rays	11	11	11	11	11
Second Anal Rays	12	12	12	12	12
Scale Rows	32	32	32	32	32

POMACENTRUS REDEMPTUS sp. nov.

Pl. VI.

Eupomacentrus rectifrænum, JORDAN & MCGREGOR, Rep. U. S. Fish Commission, for 1898, p. 282, 1899 (Clarion and Socorro Islands).

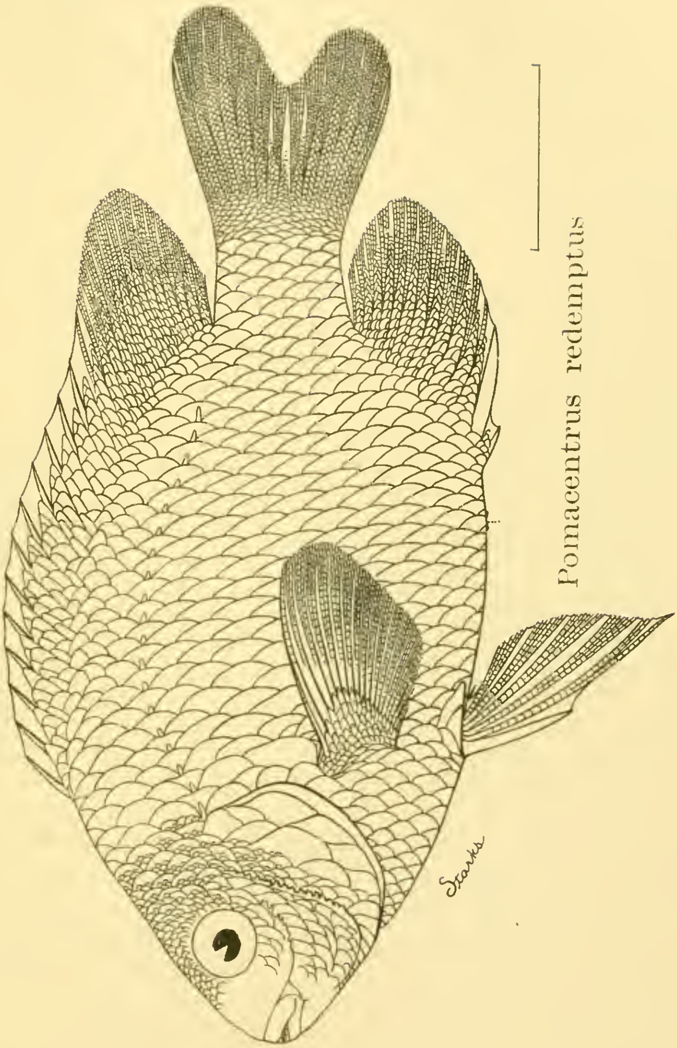
Eupomacentrus flavilatus, JORDAN & MCGREGOR, Rep. U. S. Fish Commission for 1898, p. 282, 1899 (Socorro, Clarion and San Benedicto Islands).

Type. — Cat. No. 6358, Leland Stanford Jr. University Museum. Clarion Island, Revillagigedo Archipelago. (Collector: R. C. McGregor.)

Diagnosis. — Forehead very evenly retreating from snout to front of dorsal; preopercle narrow, about two thirds of eye in adult; interorbital space about equal to eye; preopercle more strongly serrated than in *P. leucorus;* lips dark; young with posterior part of the body, caudal peduncle and posterior half of soft dorsal orange; color otherwise brown, with diffusion of orange posteriorly in adults.

Description of the Type. — Length 110 mm. Profile from snout to first dorsal straight, inclined backward at angle of about 45° with longitudinal axis of body. Dorsal spines gradually increasing in length posteriorly. Median rays of soft dorsal longest, reaching a little past base of caudal fin; last rays very short; profile of dorsal fin straight and horizontal from fourth spine to longest soft ray, so that both spines and soft rays successively more inclined backward posteriorly, the posterior longer ones being no higher than the anterior shorter ones in unelevated fin. Last soft rays horizontal. Anal similar to soft dorsal. Lobes of caudal rounded, upper lobe the larger. Upper rays of pectoral longest.

Depth two; head a little less than three; D. XII, 15; A. II, 12; eye three and four sevenths in head; least depth of preorbital one and one half in eye.



Pomacentrus redemptus

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Interorbital space a little wider than diameter of eye. Suborbital gradually decreasing in width as it curves upward and backward below eye; inferior margin with irregular serrations. Upper limb of preopercle a little inclined backward from angle; serrature well developed, obsolete at angle. Several conspicuously enlarged scales on the opercle, one very large one above base of pectoral; twenty-five oblique scale rows on body. Lateral line continuous, crossing the first nineteen rows of scales, ends below middle of soft dorsal.

Color in Alcohol.—Brown, paler on caudal fin and peduncle; lips dark like rest of head; posterior borders of scales of body darker, forming dusky vertical stripes; a distinct black spot on upper edge of base of pectoral, not in axil.

Variations.— The preceding description of the type applies almost without change to the other adult specimens. In some, the upper limb of the posterior preopercular margin is inclined backward more than in the type, while in others it is less so, being in some almost vertical.

Young Specimens.— One immature specimen 72 mm. long has the anterior upper profile somewhat rounded, resembling in this respect *E. arcifrons*. Another 60 mm. long, however, has the profile the same as in the adults. These specimens, especially the smaller one, have the caudal peduncle, basal part of caudal fin, posterior part of body back of middle of soft dorsal, and posterior half of soft dorsal pale orange. In all ages the spot on the base of the pectoral is very distinct. In the specimen which is 60 mm. in length one scale on the back of the caudal peduncle is dusky posteriorly, forming a rather prominent mark on the prevailing yellow color.

There is no trace of spots on the scales of any of the specimens.

The species is known only from Clarion, Socorro and San Benedicto Islands of the Revillagigedo Archipelago.

MEASUREMENTS OF *Pomacentrus redemptus.*

Length in mm	110	107	107	106	106	72	60
Depth	52	52	50	52	54	50	50
Head	32	31	30	30	31	31	30
Pectoral	29	29	28	26	27	31	28
Ventral	29	28	31	30	30	38	37
Eye: Head	28	27	28	29	32	33	33
Interorbital: Head	28	28	33	30	29	27	28
Preorbital: Head	17	16	17	17	16	17	15
Dorsal Spines	XII	XII	XII	XII	XII	XII	XII
Second Dorsal Rays	15	15	15	15	15	15	15
Second Anal Rays	13	13	13	13	13	13	13
Scale Rows	25	25	25	25	25	25	25
Scales on Lateral Line	19	19	20	20	20	20	20

POMACENTRUS ARCIFRONS sp. nov.

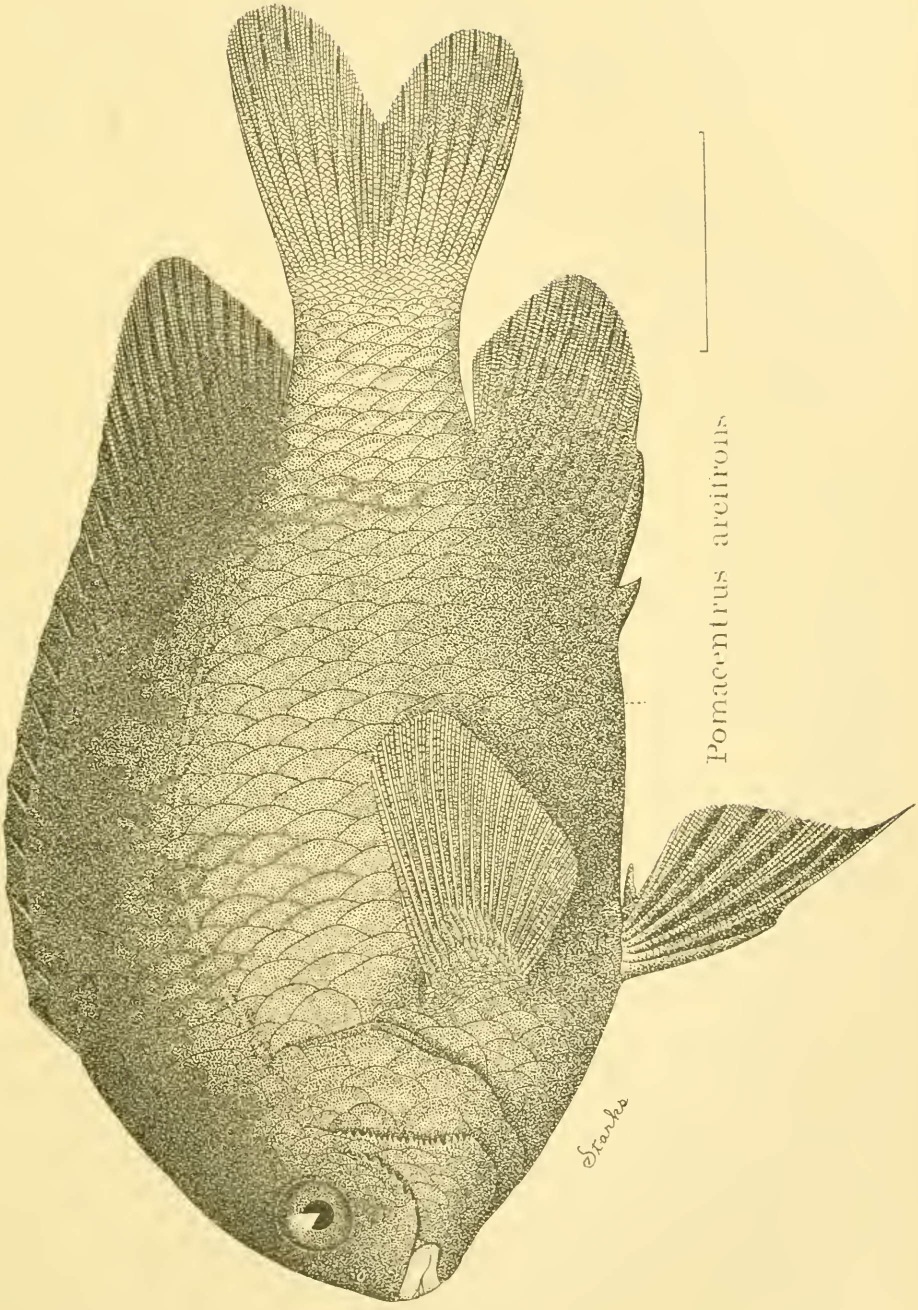
Pl. VII.

Type. — Cat. No. 6356, Leland Stanford Jr. University Museum. Barrington Island.

Diagnosis. — Profile from snout to front of dorsal regularly arcuate, forehead convex; least depth of preopercle less than eye, but relatively greater than in *P. leucorus* or *P. redemptus*; interorbital space greater than eye; upper limb of opercle vertical, rather coarsely serrated; lips orange, contrasting conspicuously in color with the brown color of the head and fore part of the body; young without spots on the scales, orange posteriorly.

Description of the Type. — Depth of body a little more than one half its length. Profile from tip of snout to front of dorsal steep, regularly curved, thence to tip of soft dorsal, profile nearly straight. Posterior border of soft dorsal receding. Profile of body descending from front of spinous dorsal to caudal. Mouth on a level with upper edge of base of pectoral and lower edge of caudal peduncle. Ventral profile of body regularly curved. Anal fin similar in shape to soft dorsal; caudal forked, the upper lobe the larger. Head three and one third in length; eye three and two thirds in head; interorbital space about three in head; preorbital a little narrower than diameter of eye; maxillary reaching slightly back of front of eye. Posterior margin of the preopercle vertical with slender serrations. Suborbital with larger, wider, less numerous serrations. Teeth rather firmly fixed, a single row in each jaw, compressed basally, flattened antero-posteriorly at tip; D. XII, 15; A. II, 13. Dorsal spines all about the same length, the first two in head; median soft rays elongated; the last shortest; first anal spine three in second; second one and two thirds in head. Pectoral wide, fan-shaped, the upper rays longest, slightly shorter than head; outer angle of ventral prolonged into a filament, about three in length. Scales large, 5–25–10. Lateral line ending a little in front of posterior end of soft dorsal; pores on twenty scales.

Coloration in Alcohol. — Dark brown, with diffusion of orange over posterior parts, color varying greatly in different specimens. All have the fore parts brown and nearly all have the posterior parts orange; but the proportions of the two colors are very indefinite, some specimens being nearly all brown and others almost wholly orange.



Pomacentrus arcifrons

Young specimens. — Numerous young specimens of this species, in the collection, are easily distinguishable at all stages from the young of *Pomacentrus leucorus* by the bright yellow color of the caudal peduncle and posterior parts of the body.

I. *Specimen 51 mm. long.* — Color and outline about same as in adult. Lips pale; area on middle of soft dorsal somewhat darker than rest of fin when held to light; posterior part of caudal peduncle and tail pale yellow. Forehead steep as in adult. A specimen of about this size (59 mm. long) was colored in life as follows: above blackish-olive; belly, cheeks and chin brownish; caudal peduncle and caudal fin orange; pectoral olive; anal dark olive, purple spot at base of last ray; spinous dorsal like back, first soft rays orange-tipped, last rays of soft dorsal olive with purple spot at base; ventrals blackish, membrane brown.

II. *Specimen 37 mm. long.* — Colored same as last, except that the whole caudal peduncle is covered with orange which encroaches on hind part of body and on last rays of soft dorsal and anal.

III. *Specimen 33 mm. long.* — Yellow covers more of posterior part of body and about posterior half of soft dorsal. Dark area on fore part of soft dorsal more distinctly outlined as a round spot.

IV. *Specimen 29 mm. long.* — Same as last, except that dark spot is still more distinctly formed on soft dorsal. Specimens of this age are almost identical in shape with adult specimens of *Pomacentrus flavilatus.*

V. *Specimen 24 mm. long.* — Orange of posterior part of body very light, covering caudal peduncle, posterior part of body as far forward as middle of soft dorsal fin, posterior half of soft dorsal and last two rays of anal; large round dark spot (specimen in alcohol) very distinct on front half of basal three fourths of soft dorsal, extending also on side of back almost to lateral line; caudal fin gray; lips dark.

The characters described in the preceding paragraphs may be summarized as follows: The very young are characterized by having the anterior part of the body plain dark brown, the posterior part, including that part back of the middle of the soft dorsal fin, the posterior half of the soft dorsal, the posterior two rays of the anal, and the caudal peduncle, bright orange; contrasting strongly with the anterior dark part. They have also a large, round, dark spot (perhaps dark purple in life) on the fore-part of the soft dorsal fin and the adjoining region of the back. In this stage the lips are not colored differently from the rest of the head and the upper profile of the head is much less steep than it is later in life. As age increases, the spot on the dorsal disappears and the lips become pale-colored, while the orange color of the posterior parts retreats backward until the individual is about 50 mm. long, when it is confined to the posterior half of the caudal peduncle. Later the orange color becomes spread indefinitely over the posterior half of the body, differing in extent in different individuals, but it generally does not cover such a distinctly defined area as in the young. Towards maturity the profile of the head becomes very steep and convex before the eyes, in some individuals almost vertical.

A large series of this species taken at the Galapagos Archipelago and at Cocos Island.

MEASUREMENTS OF *Pomacentrus arcifrons*.

Catalogue No. Leland Stanford Jr. University Museum.	(Type) 6356.	12294.	12295.	12296.	12297.	12298.			
Length in mm	115	110	108	107	107	99	52	34	24
Depth	57	58	59	54	59	49	49	47	43
Head	30	29	33	30	32	31	32	32	33
Pectoral	29	28	28	27	29	28	30	30	27
Ventral	32	34	32	30	30	30	36	39	31
Eye: Head	27	28	27	26	28	28	33	34	34
Preorbital: Head	22		21	21	19	19			
Interorbital: Head	35	34	32	32	31	33	25	27	24
Dorsal Spines	XII	XII	XII	XII	XII	XII			
Second Dorsal Rays	15	15	15	15	15	15			
Second Anal Rays	13	13	13	13	13	13			
Scale Rows	25	24	25	24	25	25			
Scales on Lateral Line	20		20	19	20	20			

The species of *Pomacentrus* living along the mainland of Central America is *P. rectifrænum* shown in Figure 2 of Plate v. It has been reported from the Revillagigedo Archipelago, but the specimens are probably young individuals of *P. redemptus*.

Nexilosus gen. nov.

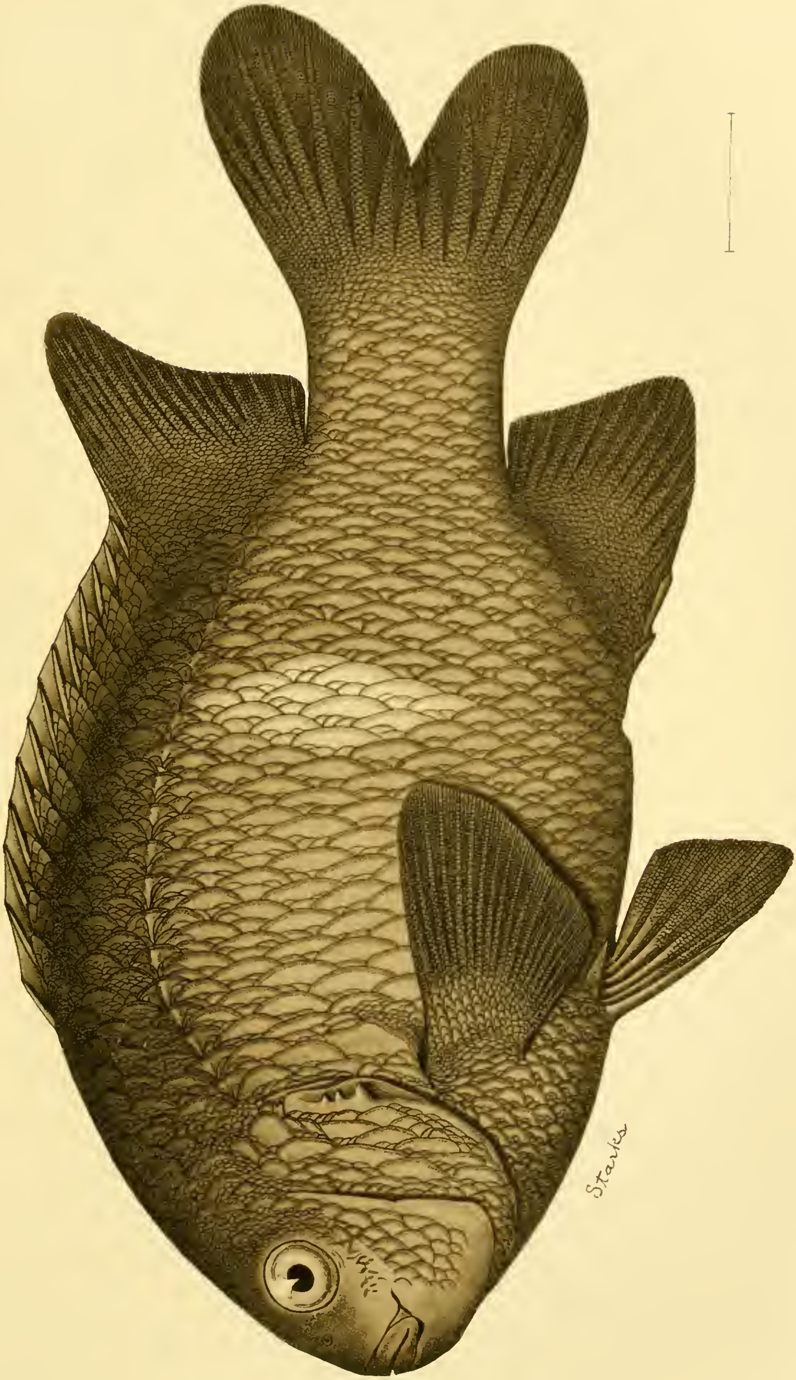
Characters. — Teeth incisor-like, entire; suborbital adnate to cheek; no scales on preorbital, scales on suborbital not well formed; fourth gill opening a very small round aperture. These are all *Hypsypops* characters except the adnate condition of the suborbital, which is a characteristic also of *Nexilarius*.

NEXILOSUS ALBEMARLEUS sp. nov.

Pl. VIII.

Type. — Cat. No. 6359, Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.

Description of the Type. — Length 200 mm. Body ovoid, deep, compressed; depth a little more than two in length; profile from



Nexilosus albemarleus

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snout to dorsal fin arcuate, very steep; lower profile of body less convex than upper; greatest depth at middle of body. Head about three and one half in length; mouth on level with lower edge of caudal peduncle, small, curved slightly downward behind; lips thick. Teeth in a single series, laterally compressed, somewhat antero-posteriorly compressed at tips, entire. Nostril a little below eye, midway between eye and premaxilla. Eye four in head. Suborbital adnate to cheek, outline of inferior border visible; posterior limb of preopercle vertical; angle of opercle with a small flat spine; two smaller ones in a crescentic notch on posterior border above angle.

D. XIII, 17; A. II, 13. Dorsal spines all low, of uniform height, except first and second which are shorter than the others; soft dorsal abruptly higher than the spinous dorsal; anterior rays highest, almost as long as head; posterior rays rapidly decreasing to last which is lower than last dorsal spine; distal border of fin vertical, a little concave. Second anal spine the longer, equal to last dorsal spine. Middle rays of anal longest, about four fifths of longest dorsal ray; posterior rays somewhat longer than posterior dorsal rays, but base of fin ends a little in advance of base of dorsal so that the posterior borders of fins are about opposite. Depth of caudal peduncle one and one half in head, dorsal and ventral outlines straight; caudal fin deeply divided into two rounded lobes, the upper considerably the larger. Pectorals one and one sixth in head, fan-shaped, but upper rays longest. Ventral simple, rays not produced, one and one fifth in head.

Scales 4–28–12, those along middle of sides largest, most of them with small accessory scales at their bases, these most numerous above lateral line. Entire body scaled except circum-oral region as far back as eyes; scales on suborbital not well formed. Fins all densely scaly; spinous part of dorsal with scaly sheath almost concealing the spines. Lateral line on twenty-two scales, ending below posterior part of soft dorsal.

Coloration in Life — Sides bluish-brown, back with scales hazel in center, dark brown peripherally; a broad light-rusty vertical bar on sides above anus, tapering above and below, snout light brownish-red; fins dusky; lips dusky-bluish; belly and sides of head light brown; iris blue.

The different specimens present but little variation. The crescent-shaped notch which is present in all specimens on the posterior border of the opercle above the spine is covered with membrane. Some specimens have two small spines in the notch, as in the *type*, while in others these are lacking. The second dorsal is proportionally lower in specimens smaller than the *type*.

Young (40–62 mm. long).—General shape same as that of adults. Teeth entire; preorbital and suborbital scaleless; preorbital a little less in depth than in adults (in adults almost equal to eye, five in head), in young two in eye, seven in head, but eye much larger in young, three in head (in adults four and one fourth in head). Color, above black with bluish iridescence; head and base of anal and dorsal with bright blue spots.

This species was taken at Tagus and Iguana Coves and Elizabeth Bay, Albemarle Island.

MEASUREMENTS OF *Nexilosus albemarleus.*

Catalogue No. Leland Stanford Jr. University Museum.	(Type) 6359.	12290.	12291.	12292.	12293.
Length in mm	200	193	193	170	166
Depth	54	52	55	52	57
Head	29	28	30	29	30
Eye : Head	24	24	24	23	23
Longest Dorsal Ray : Head	84	79	75	70	80
Longest Anal Ray : Head	63	60	63	60	63
Pectoral : Head	92	89	90	82	90
Ventral : Head	84	85	86	77	85
Dorsal Spines	XIII	XIII	XIII	XIII	XIII
Second Dorsal Rays	17	18	18	18	18
Second Anal Rays	13	15	13	14	14
Scale Rows	28	28	28	28	27

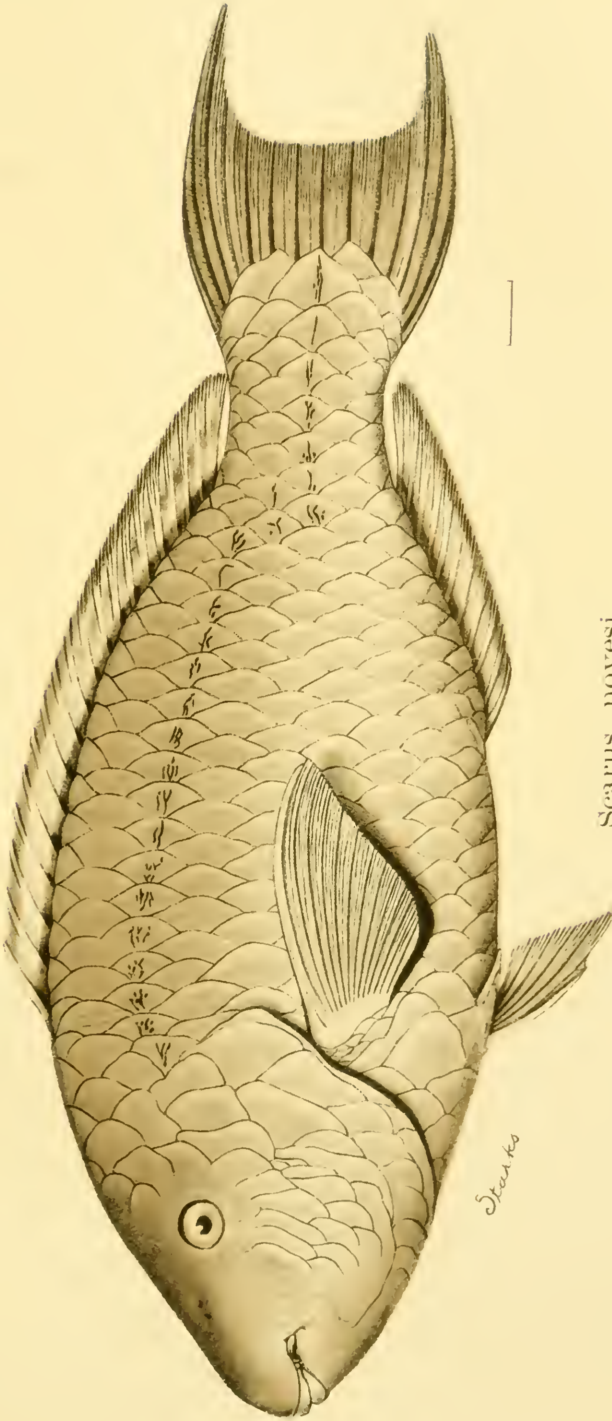
SCARUS NOYESI sp. nov.

Pl. IX.

Type.—Cat. No. 12332, Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.

Description of the Type.— Length 428 mm. Depth two and one half; head two and two thirds; D. IX, 10; A. III, 9.

Dorsal and ventral outlines evenly rounded, the dorsal a little more convex than the ventral. Snout blunt, thick, rounded symmetrically with lower jaw; profile before eye very slightly concave. Upper lip leaving marginal space of jaw exposed for about one third the width of eye; lower jaw with a somewhat wider exposed space; margin of upper lip horizontal, of lower oblique, forming an angle of 30° with margin of upper. Dental plates white, upper with two small, conical, outwardly directed posterior canines at angle of lips. Nostrils very small, anterior circular, posterior a longitudinal slit. Eye, eight in head. Six vertical rows of scales on cheek below eye; first, second and fourth of two scales each; third of three scales, fifth of four scales



Scarus noyesi

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and sixth of two scales placed high so that the upper overlaps the lower anterior scale of scaly area behind eye; opercles with large scales. Snout, lower jaw, top of head before eyes and circum-ocular region naked. Dorsal fin begins at vertical from base of pectoral, of uniform height throughout except posterior end which is a little elevated. Caudal peduncle deep, outlines concave, depth two and two fifths in head; upper and lower outlines of caudal fin convex, angles produced, median posterior margin straight; middle rays two in head, upper rays two thirds longer, lower about one half longer than median rays, upper and lower rays thickened. Anal similar to soft dorsal, highest posteriorly; spines three, the first very small, hidden beneath the skin close to the second. Second and third of equal size, same length as anterior soft rays of anal; pectoral of fourteen rays, the upper the longest, one and one third in head. Ventrals simple, short, two in head.

Scales large, twenty-two oblique series along lateral line. Lateral line beginning on fourth scale from ridge of back, and running backward over sixteen scales of third row below dorsal fin, then interrupted, beginning again on second scale below in same oblique series, and running backward over five more scales on middle of side of caudal peduncle.

Coloration in Alcohol. — Plain green, dorsal and anal with green base and margin, yellow mesially; dorsal with a small, median series of dark spots posteriorly.

Coloration in Life. — Above light brownish-gray, with bluish-green iridescence, pinkish below, brightest on throat, chin and lips; dorsal with light blue-green margin and base; pectorals light yellow, first ray blue; ventrals pinkish; anal pinkish-brown with light-blue spots; caudal light brownish like body with first upper and first lower rays blue-green; blue spot above eye; snout dark olive above; iris golden.

Another specimen was light olive-brown above, greenish on sides with pink margined scales.

Variations. — The number of scales in the different rows on the cheek varies somewhat, but there are always six in the arc formed beneath the eye by the uppermost scales of each vertical series. The smaller specimens have the angles of the caudal less produced than the larger ones such as the *type*. The tubes of the lateral line are irregularly branched on each scale. The two parts of the lateral line generally overlap on one scale row only, but occasionally on two.

Our specimens are from Albemarle, Narboro, Duncan and Seymour Islands.

Named for Captain Wm. P. Noyes, the sailing master of the expedition.

MEASUREMENTS OF *Scarus noyesi.*

Catalogue No. Leland Stanford Jr. University Museum.	12273.	12274.	12275.	12276.	12277.	(Type) 12332.	12278.
Length in mm	300	342	357	365	380	428	455
Head	28	31	28	31	31	34	32
Depth	36	37	37	38	37	39	38
Pectoral: Head	70	71	82	76	78	78	83
Ventral: Head	64	52	65	54	55	50	53
Eye: Head	15	14	16	14	14	13	13
Dorsal Spines	IX	IX	IX	VIII	VIII	IX	IX
Second Dorsal Rays	10	10	10	10	11	10	10
Second Anal Rays	9	9	9	9	9	9	9
Scale Rows	24	23	23	23	23	24	23

PONTINUS STRIGATUS sp. nov.

Type. — Cat. No. 6343, Leland Stanford Jr. University Museum. Wenman Island.

Diagnosis. — Snout and maxillary scaled; tentacles short or wanting on head; preopercle with four spines, upper with a supplemental spine at base, humeral spine single; last dorsal spine much longer than the eleventh; pectoral rays eighteen, extending past beginning of anal; lateral line with twenty-four pores; head two and five eighths; eye three and one sixth. Color bright red, streaked and spotted with olive-brown.

Description of the Type. — Head two and five eighths in length; depth three and one fourth; eye three and one sixth in head; interorbital nine and one half; maxillary two; snout three and one sixth. D. XII, 10; A. III, 5; P. 18.

Eye large, three and one sixth times in length of head. Snout short, equaling diameter of eye in length; interorbital region deeply concave, narrow, width three times in eye; occipital flat, bordered by low spines; nape rising obliquely from occiput. Paired nasal, preocular, supraocular, postocular, tympanic and parietal spines present; nape with two pairs of nuchal spines; humeral and paroccipital spines single; suborbital carina with three spines; preopercle border armed with four spines below angle, the first largest and with a supplemental spine at its base, the third spine larger than second; opercle with two broad flat spines, one situated at the angle. Head with short filaments at the bases of some of the spines, other filaments wanting. Maxillary extending to the vertical from middle of pupil, length one half of head. Gill-rakers free, short, length at angle one third the eye.

Lateral line beginning at humeral spine and extending horizontally to the tail; pores twenty-four. Scales small, finely ctenoid; covering the body, snout posteriorly, the occiput, cheeks, opercles and maxillary; fin membranes, tip of snout, interorbital, premaxillary and lower jaw naked.

Spinous dorsal high, third spine highest, equaling one half head; eleventh spine much shorter than the twelfth; first spine shorter still. Soft dorsal lower, rounded, height three and one fourth in head. Anal fin high, second spine much larger and heavier than third, its height slightly less than one half the head. Soft anal higher than the spinous, rays more or less free at tip. Ventrals long and pointed, extending to first anal spine. Pectorals broad and fan-shaped, median rays longest, reaching third anal spine.

Coloration in Life. — Above bright red, the belly lighter, pinkish, dorsum and head above the level of the preopercular spine spotted or indistinctly streaked with dark olive-brown, spotted heaviest about the base of the dorsal fin; sides below the dorsal fin streaked obliquely with olive-brown; fins, spines and rays red, the membranes whitish, yellowish in the dorsal; the soft dorsal and caudal fins spotted with olive-brown; upper half of pectorals olive spotted; the soft anal with a dusky central streak.

In general form and coloration this species approaches *P. sierra* Gilbert, from the Gulf of California, but differs in the scaled maxillary, the higher and differently proportioned spinous dorsal and in the greater number and streaked character of the dark markings.

The *type* was taken from the stomach of a shark (*Carcharhinus platyrhynchus*) near Wenman Island.

MEASUREMENTS OF THE TYPE OF *Pontinus strigatus*.

Catalogue No. 6343 Leland Stanford Jr. University Museum.	
Length in mm	75
Head	38
Depth	31
Eye	12
Interorbital Width	4
Maxillary	19
Snout	12
Height of Spinous Dorsal	19
Height of Spinous Anal	20
Pectoral	30
Ventral	26
Depth of Caudal Peduncle	10

ELEOTRIS TUBULARIS sp. nov.

Pl. X.

Type. — Cat. No. 6348, Leland Stanford Jr. University Museum. Cocos Island.

Diagnosis. — Scales 46, 16; eye greater than interorbital width; anterior nostril tubes extending beyond mouth; maxillary reaching to below middle of eye. Head long, two and sixth sevenths in length.

Description of the Type. — Head two and sixth sevenths in length; depth four and three fourths; width of head four and one sixth; eye four and one half in head; maxillary two and three fifths; interorbital five; D. VI–I, 8; A. I, 8; scales 46, 16.

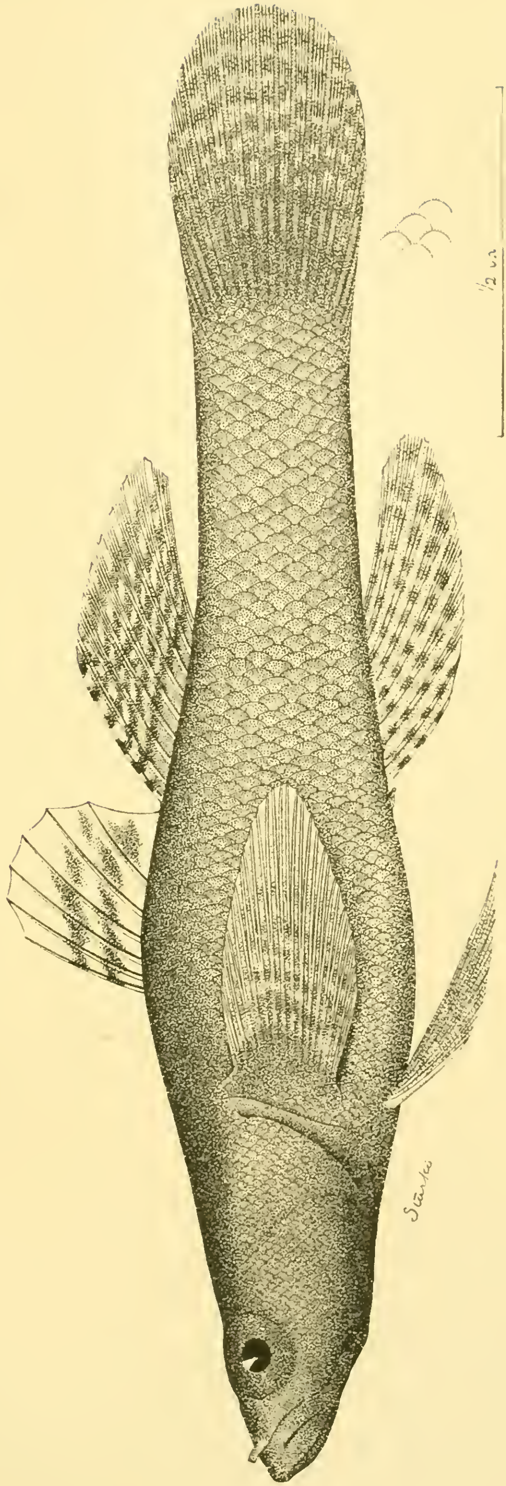
Body short and compressed posteriorly. Dorsal profile low, highest at the beginning of the dorsal fin, descending obliquely to tip of snout. Head broad and depressed; interorbital region flat or slightly concave; mouth large, oblique, with lower jaw projecting. Teeth in both jaws small and subequal. Maxillary long, extending to vertical from middle of pupil. Anterior nostril with long tubes extending considerably beyond the snout. Preopercular spine blunt, concealed and turned forward.

Scales large, ctenoid, forty-six in a line from angle of opercle to end of vertebræ; sixteen longitudinal series between dorsal fin and ventrals.

Dorsal fins separated by a slight interspace, spinous portion rounded and slightly lower than soft portion; soft dorsal attached to seventh spine, angular in outline, all the rays being of nearly equal length. Anal fin similar to soft dorsal but more rounded, beginning posterior to origin of soft dorsal. Caudal fin long, three and one fourth in length, rounded. Pectorals obtusely pointed, reaching beyond origin of anal fin, rays sixteen. Ventrals pointed, inner rays longest, separated by an interval slightly more than one half the eye.

Coloration in Alcohol. — Above olive-brown, darkest on the head and snout; belly lighter brownish; dorsal, anal and caudal fins closely barred with dusky; pectoral and ventral fins lighter, with less conspicuous dusky bars.

The nearest American ally of this species is *E. amblyopsis* of Surinam from which it differs chiefly in the much larger eye and longer head.



Eleotris tubularis

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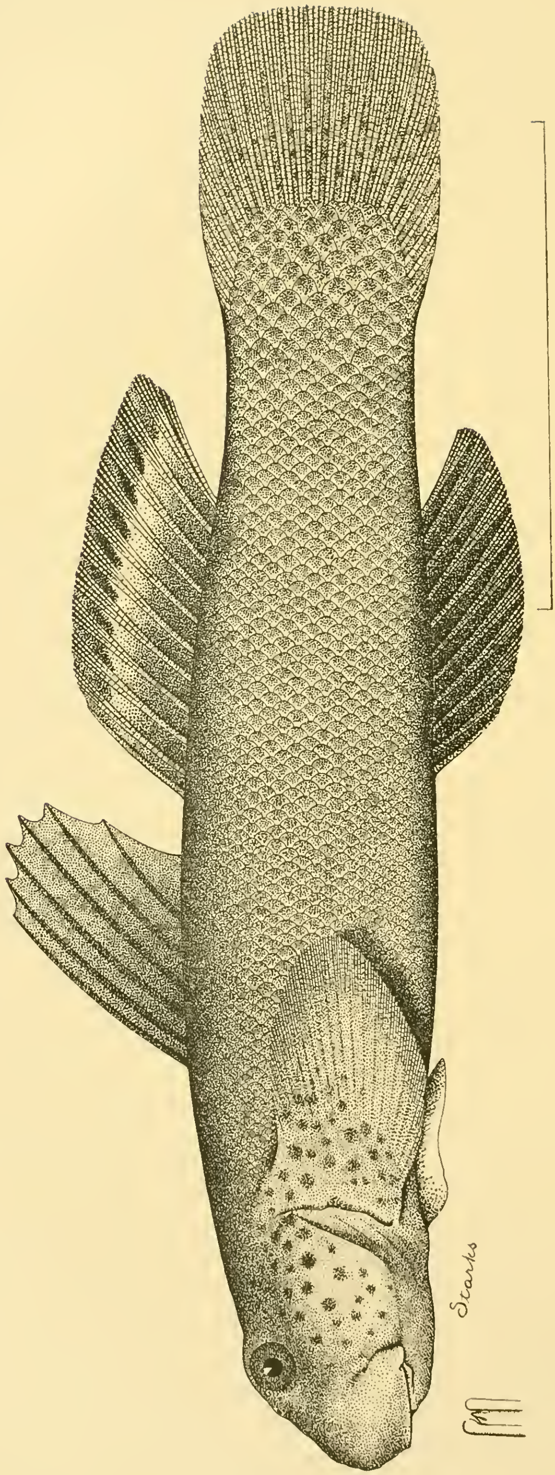

Cotylopus cocoensis

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MEASUREMENTS OF THE TYPE OF *Eleotris tubularis*.

Catalogue No. 6348 Leland Stanford Jr. University Museum.	
Length in mm	41
Head	35
Depth	23
Width of Head	24
Eye	8
Maxillary	13
Interorbital Width	7
Snout	8
Pectoral	27
Ventral	19
Height of Spinous Dorsal	13
Height of Soft Dorsal	16
Height of Soft Anal	18
Caudal	31
Depth of Caudal Peduncle	15
Length of Caudal Peduncle	23

COTYLOPUS COCOENSIS sp. nov.

Pl. XI.

Type. — Cat. No. 6347, Leland Stanford Jr. University Museum. Cocos Island.

Diagnosis. — Scales cycloid, large, fifty-six in a line from opercle to end of the vertebræ; head, throat, disc and fins naked; teeth of upper jaw tricuspid, those of mandible equal and separated; eye small, six times in head; lips without emarginations; pectorals short.

Description of the Type. — Head four and one fifth in length, depth four and four fifths; eye six in the head, maxillary two; interorbital two and one half; D. VI–I, 10; A. I, 10; scales 56.

Body subcylindrical anteriorly, becoming posteriorly more compressed; dorsal and ventral outlines nearly parallel. Head high and bluntly rounded anteriorly; snout broad and flat, obtusely rounded; interorbital region slightly concave. Nape with a median depression or groove extending from the occiput to dorsal fin. Mouth wide, inferior; lips with even margins, lower with two broad posteriorly situated papillæ on gums. Teeth of upper jaw in a single series, numerous, slender and brush-like; tip bent at right angles; cutting edges tricuspid or trident-shaped; but soon becoming worn down even. Teeth of mandible subequal, well separated; five on each side of jaw, anterior pair slightly smaller than posterior. Eye small, contained six times in length of head, one and three fourths times in interorbital width. Maxillary extending to vertical from posterior border of eye.

Scales large, subequal, smallest on the nape, larger on the sides; fifty six in a line from the angle of the opercle to the last vertebra. Scales cycloid with the exception of a few on the sides which are armed with several serrations medially. The body scaled excepting the throat; the head, fin membranes and disc naked.

Dorsals separated by an interval equal to three fourths the length of the maxillary. Spinous dorsal high, spines more or less free and flexible at the tip, third and fourth spines highest, contained one and one fifth times in head. Soft dorsal longer and lower, rays of about equal length. Anal fin similar to soft dorsal but lower and anteriorly more rounded. Pectoral short, one and two fifths in head, obtusely pointed; caudal short, broad and truncate at the tip. Ventral disc small, circular.

Coloration in Life. — Above dark brownish-olive, thickly spotted with green and black spots the size of the scales; sides of the body lighter olive; head above and on sides blackish; belly dusky-olive, unspotted, medially bluish; disc amber-yellow, bordered anteriorly with maroon; dorsals dusky, maroon-tipped, the soft portion with a black median stripe; pectorals dark brown, broadly maroon-tipped, the basal portion olive with dusky spots; anal blackish; caudal broadly maroon-tipped, the basal part dusky; iris silvery.

The shape of the teeth and distribution of the scales ally this species to *S. salvini* of Panama from which it differs in the larger and cycloid scales and in coloration.

The species was found abundant in the streams about Chatham Bay.

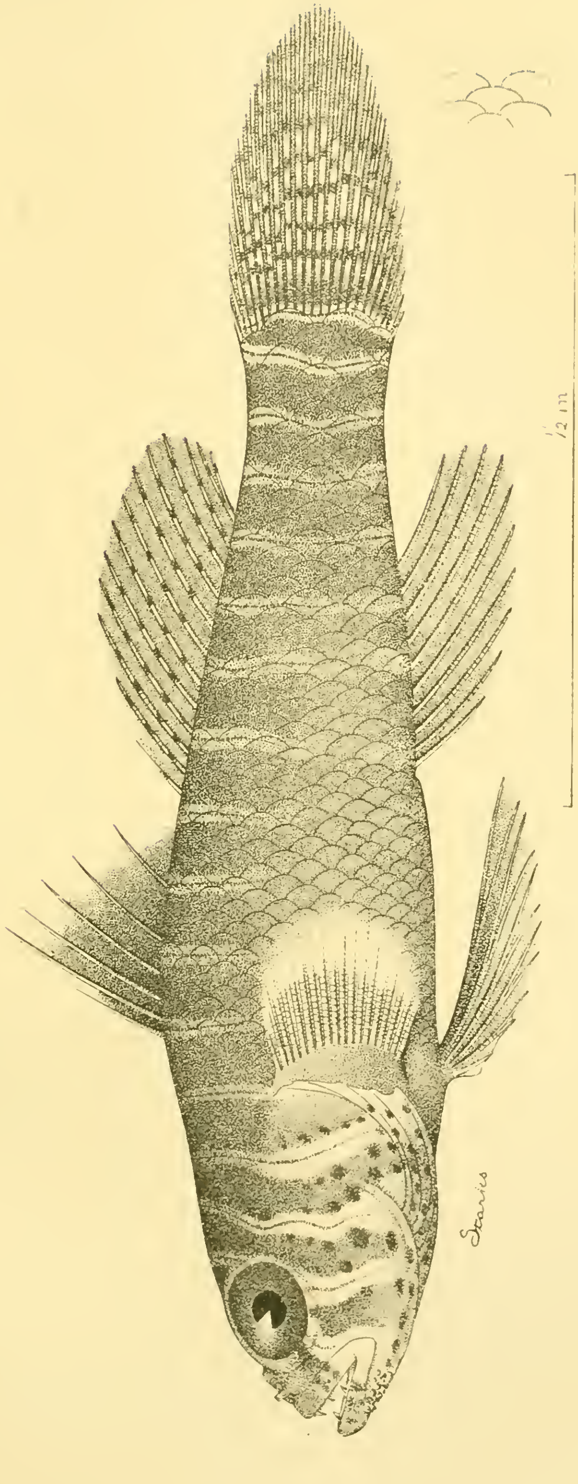
MEASUREMENTS OF *Cotylopus cocoensis.*

Length in mm.	63	80	52
Head	24	22	24
Depth	21	21	18
Eye	04		4
Interorbital Width	07		7
Maxillary	12	11	11
Height of Spinous Dorsal	19	22	18
Height of Soft Dorsal	14	13	13
Height of Anal	11	9	10
Pectoral	17	17	18
Length of Disc	14	10	14
Caudal	21	19	22
Depth of Caudal Peduncle	15	14	14

GOBIUS RHIZOPHORA sp. nov.

Pl. XII.

Type. — Cat. No. 6349, Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.



Gobius rhizophora

Diagnosis. — Head three and one third in length; depth four and one sixth; dorsal profile of head evenly rounded; snout less than eye; D. VI–I, 11; A. I, 9. Color, above dark reddish-brown, head and body crossed by fifteen light vertical bars; head below the level of eye black-spotted; caudal and dorsal fins finely dark-barred.

Description of the Type. — Head three and one fifth in length; depth four and one sixth; eye three and one half in head; maxillary three; snout three and seven eighths; interorbital ten and one third; D. VI–I, 11; A. I, 9; caudal 27; pectoral 18.

Body short, dorsal and ventral profiles low and subequal. Head slightly compressed, width less than height, dorsal profile slightly rounded from snout to nape. Snout short, less than diameter of eye in length. Mouth oblique, with projecting lower jaw; maxillary one third length of head, extending to slightly beyond vertical from anterior border of eye. Teeth in a double series in both jaws; inner small and villiform; the outer enlarged, canine and spaced. Eyes diameter large, greater than snout, situated close together, the interorbital consisting of a thin ridge.

Scales large, ctenoid, twenty-eight in a line from base of pectoral to caudal fin. Whole head, breast, nape, base of spinous dorsal and fin membranes naked.

Dorsal fin long, deeply notched before last dorsal spine. Spinous dorsal high, second and third spines somewhat produced but considerably shorter than in *G. zebra*, about one half head in height. Soft dorsal lower, with rays of about equal height, a few of the posterior shorter, not reaching base of caudal fin. Anal fin similar to soft dorsal, but not extending so far posteriorly, height equal to soft dorsal, posterior rays nearly as long as others, pectorals in the type with the tip of the rays worn; normally pointed, one and one ninth the length of head. Ventrals jointed, inner rays longest, as long as pectorals; reaching anus. Caudal rounded, one and one fourth in length of head.

Coloration in Alcohol. — Above, head and body dark purplish-brown; body crossed by thirteen narrow, light, vertical stripes, about one fourth as wide as the dark interspaces, becoming obsolete on sides anteriorly, the light stripes with a fine dark line running through them; head crossed by two oblique light stripes behind the eye which cross over the nape; a pair below eye and a single posterior interorbital stripe above eye; light spaces on head wider than on body, distinct, not forming reticulations; head below level of eyes and belly lighter, pinkish; the dark areas below eye, the chin and branchiostegal membranes spotted with dark brown; soft dorsal and caudal fins light, barred with blackish; spinous dorsal dark like back but becoming lighter at tip; ventrals and pectorals light without darker markings; anal fin dusky.

All the specimens agree in proportions and coloration with the *type*. The fins in most of the specimens are in poor condition.

Allied to *G. zebra*, which species it resembles in proportions, shape and fin characters. This species apparently is marked with light stripes where *G. zebra*, possesses dark ones, the darker median stripes in the light areas·being represented by the darker median stripe in the dark stripes of the latter. The light stripes do not form reticulations below the eye as do the dark stripes on *G. zebra*. The species differs further in the more rounded dorsal profile of the head (which, in *G. zebra* is considerably angulated and projecting before the eyes), in the lower spinous dorsal, the shorter snout, the spotted head, and dark barred dorsal and caudal fins.

In the collection are specimens from Albemarle (Tagus Cove), Narboro and Seymour Islands.

MEASUREMENTS OF *Gobius rhizophora.*

Length in mm	22.5	20	23
Head	31	29	27
Depth	24	24	22
Eye	9	9	8
Interorbital Width	3	—	—
Snout	8	8.5	7
Maxillary	10	11	10
Height of Spinous Dorsal	14+	13	15
Pectoral	14+	28	22+
Ventral	28	25	—
Caudal	23	21	24

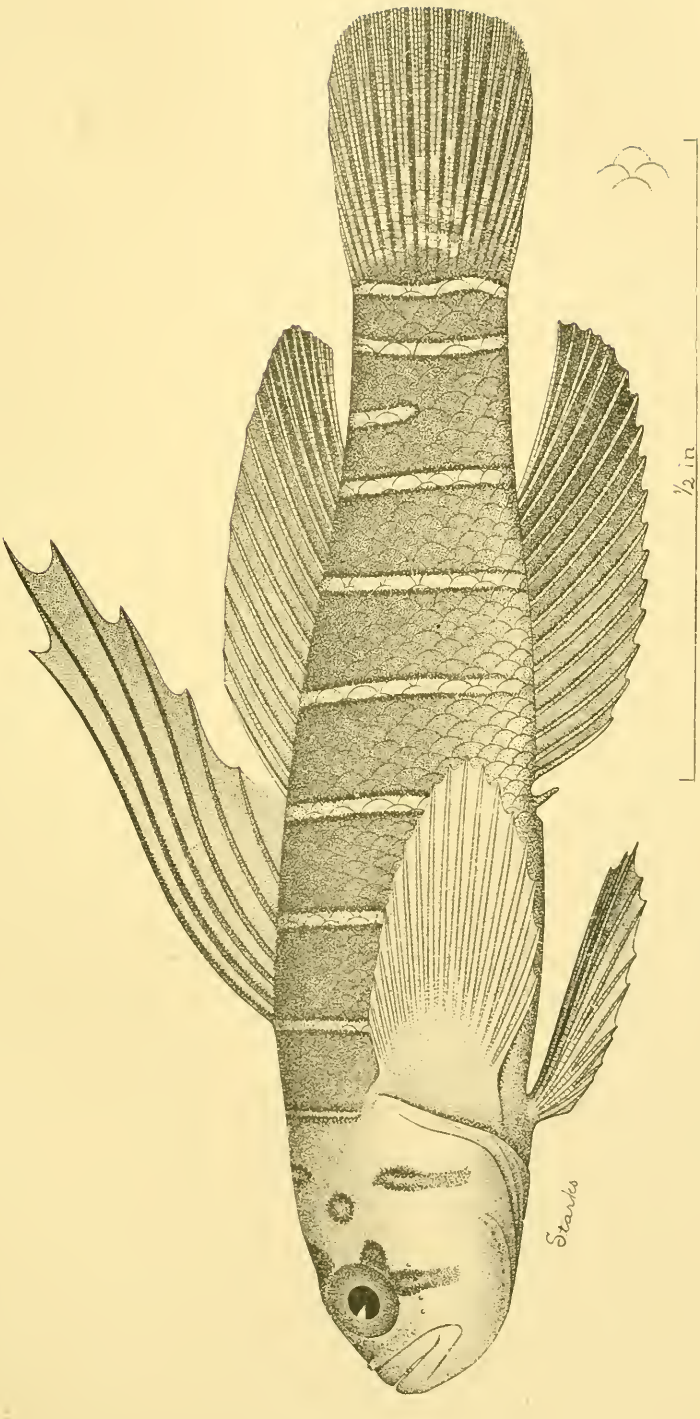
GOBIUS GILBERTI sp. nov.

Pl. XIII.

Type. — Cat. No. 6354, Leland Stanford Jr. University Museum. Narboro Island.

Diagnosis. — Jaws with two series of teeth, the outer enlarged, consisting of four canines in each jaw. Dorsal fin VI–I, 14, first four spines greatly produced, reaching much past middle of soft dorsal. Color, above dark reddish, below and on sides lavender; the sides crossed by nine narrow, vertical, black margined stripes.

Description of the Type. — Head three and two thirds in length; depth four and one half; eye three and one half in head; interorbital 7; D. VI–I, 14; A. I, 14; scales 38.



Gobius gilberti

Body short, low, with dorsal and ventral profiles subequal, moderately compressed; head with rounded dorsal profile, somewhat compressed, width equal to depth of the caudal peduncle; mouth small, oblique; tip of snout formed by the projecting mandible; maxillary short, extending to vertical from anterior border of pupil; both jaws armed with a double series of teeth, the inner series small, the outer enlarged and spaced, consisting of four canines in each jaw.

The scales finely ctenoid, large, thirty-eight in a line from base of pectoral fin to last vertebra. Head naked; body scaled excepting nape, breast, and belly mesially, which are naked. Dorsal fin deeply notched before the seventh spine, spinous part greatly produced, second spine longest and reaching twelfth dorsal ray, third slightly shorter, first spine exceeding fourth in length; all the spines flexible and united by membrane to their tips. Soft dorsal lower, little rounded anteriorly, ending squarely behind, posterior rays equaling the median in height and reaching base of caudal fin; anal fin similar to the soft dorsal in shape and equaling it in height; caudal rounded or subtruncate, equaling head in length. Pectorals pointed, upper rays atrophied, lower free at tips; median rays longest, reaching anal fin; ventrals free from belly, pointed, reaching vent.

Coloration in Alcohol.—Dark brownish, head and belly lighter brownish-yellow, body crossed by nine narrow, light, black bordered, vertical stripes; a vertical bar below eye, another on opercle, a curved interorbital, a short occipital and a nuchal bar, and two postocular spots light, bluish-black bordered like the vertical body stripes; caudal fin dusky with a few light spots at base, the other fins lighter; dorsal spines blackish.

Another specimen secured at Tagus Cove, Albemarie Island, is somewhat larger and lighter colored than the *type*, with the dorsal spines less produced, the longest reaching only to the fifth vertical stripe. The coloration in life of this specimen was as follows: Body pale-lavender, crossed by ten narrow, vertical, light-blue, black-margined stripes, these stripes obsolete on the belly; the head below the eye and the snout golden, above and on nape bright red, interorbital region olive; bars and spots on the head distributed as in the type and colored like the vertical body stripes; fins dusky, reddish tipped; iris light olive.

This species is apparently nearest *G. dalli*, of the Santa Barbara Islands, which it resembles in shape and in the character of its teeth and fins; but the dorsal spines are much more produced, the scales larger and the coloration very different in pattern.

Named for Dr. Charles Henry Gilbert, of Stanford University.

MEASUREMENTS OF *Gobius gilberti*.

Length in mm	22.5	25
Head	27	28
Depth	22	25
Eye	8	7
Snout	7	7
Interorbital Width	4	4
Maxillary	11	12
Height of Spinous Dorsal	40	24
Pectoral	32	29
Ventral	23	23
Caudal	28	26
Depth of Caudal Peduncle	13	13

ARBACIOSA TRUNCATA sp. nov.

Pl. XIV.

Gobiesox zebra GILBERT, in part, Proceedings United States National Museum, XXIII, 1890, p. 452 (Duncan Island).

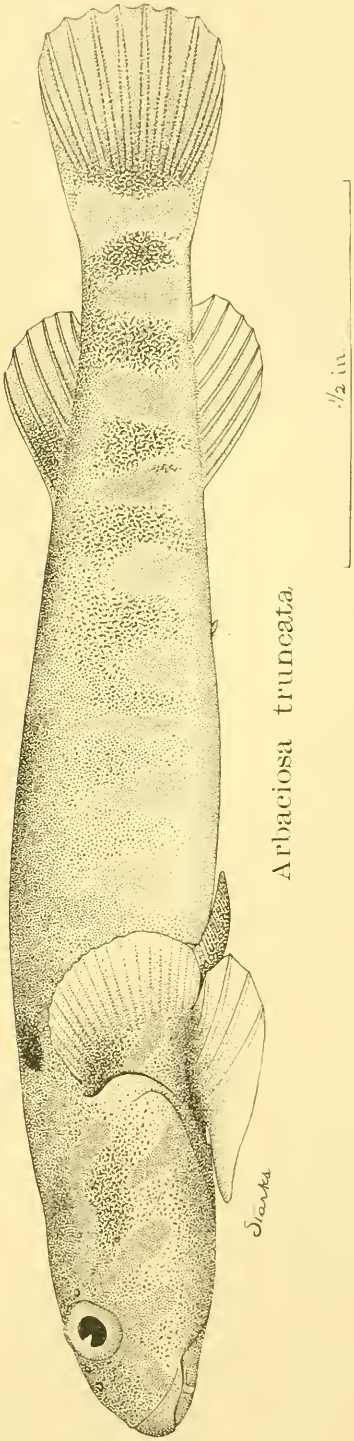
Type. — Cat. No. 6341 Leland Stanford Jr. University Museum. Tagus Cove, Albemarle.

Diagnosis. — Incisors broad, the median ones of both jaws even-edged, truncate; a single enlarged canine behind the incisors; dorsal and anal fins with six or seven rays; eye large, one and one half times in interorbital width; vertebræ thirty. Color, light olive-yellow, vermiculated and spotted above with darker; a blackish humeral spot; four pinkish transverse bands on dorsum in life.

Description of the Type. — Head three and one third in length; depth six and two thirds; eye five in head; interorbital three and three fourths; disc one and one fourth; D. 6; A. 7.

Horizontal profile of body narrow, head little wider than rest of body, opercles bulging somewhat on sides; snout rounded. Dorsal profile low, rising slightly to middle of back; ventral profile horizontal. Mouth small, terminal; both jaws armed with six broad incisors, the four median ones above and the two median ones below truncate, unnotched, their edges even; lateral teeth tridentate with rounded lobes, the middle lobe projecting above the lateral ones; both jaws with an enlarged, somewhat recurved incisor separated by a slight diastema from the posterior incisors. Gill-raker short, slender, seven on lower limb of arch. Opercular spine strong.

Dorsal fin beginning slightly in advance of anal; both fins short, similar, rounded, their anterior rays highest. Pectoral short, rounded, with broad bases, length two and one half in head. Caudal fin broad, rounded, length one and one half in length of disc.



Arbaciosa truncata

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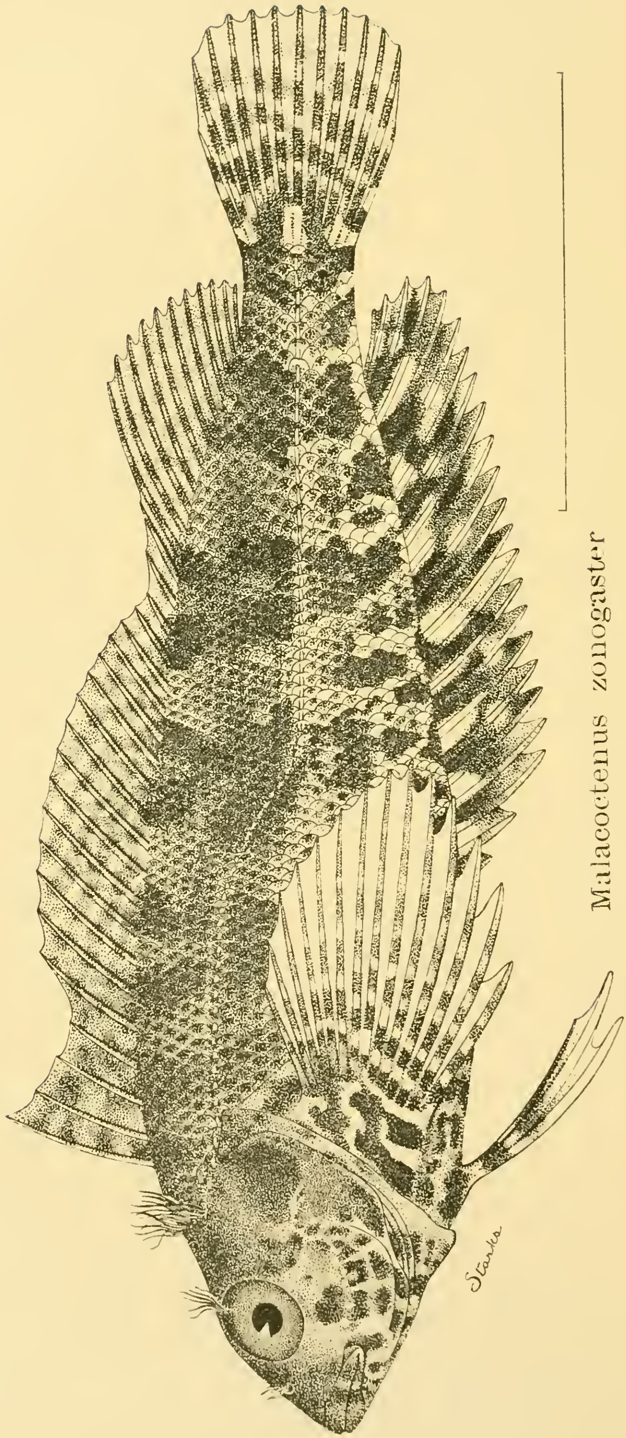


Malacoctenus zonogaster

Coloration in Life. — Above and on sides light olive-yellow, vermiculated and spotted above with slate-blue; orbit with seven radiating bluish stripes, the anterior one extending forward to mouth, the two lower ones running obliquely across cheeks and opercles; sides with twelve rather narrow bluish transverse bars, not extending on ventral or dorsal surfaces; a blackish humeral spot, slightly smaller than eye; back crossed by four broad pinkish bands, the first beginning behind the humeral spots; ventral surfaces light yellow, immaculate; fins olive, without spots, caudal fin and ventral disc edged with orange.

There is considerable variation in the coloration. The collection contains two small specimens which show five broad dark cross-bars, as in *A. zebra*; and some of the other specimens show faint traces of the same markings.

The young have all the mandibular incisors tridentate, as in the adults of *A. zebra*. The small specimens collected by the *Albatross* at Duncan Island and referred by Dr. Gilbert to *A. zebra*, were evidently too young to show the specific characters of the teeth.

Allied to *A. zebra*, differing in the truncate, unnotched median mandibular teeth and somewhat in coloration.

Numerous specimens were secured at Tagus and Iguana Coves, Albemarle Island.

MEASUREMENTS OF *Arbaciosa truncata*.

Length in mm	39	45	35	38
Head	30	29	30	30
Depth	15	15	13	19
Width of Head	26	27	27	27
Eye	6	5	5	5
Interorbital Width	8	8	8	8
Pectoral	12	14	12	12
Length of Disc	28	25	27	27
Depth of Caudal Peduncle	9	10	9	9
Length of Caudal Peduncle	10	8	10	10
Caudal	19	19	20	17

MALACOCTENUS ZONOGASTER sp. nov.

Pl. XV.

Labrisomus delalandi GILBERT, Proc. U. S. Nat. Mus., XIII, p. 452, 1890, Albemarle Island.

Type.— Cat. No. 6352 Leland Stanford Jr. University Museum. Iguana Cove, Albemarle Island.

Diagnosis.— Dorsal spines XXI or XXII, first spine higher than second, one and one half in eye; whole lower surface heavily barred and spotted with dark brown.

Description of the Type.— Head three and two thirds in length; depth three and two fifths; eye three and one half in head; maxillary three; interorbital two in eye; D. XXI, 11; A. II, 20; scales 63.

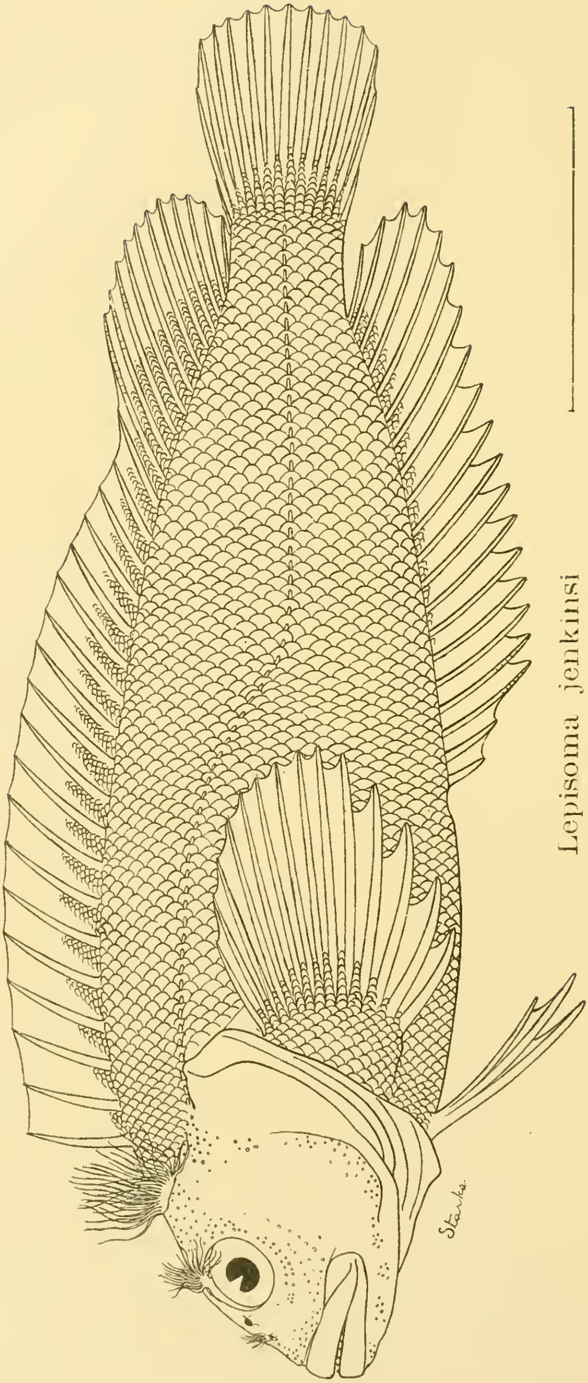
Shape of the head and body much as in *M. delalandi*, body posteriorly compressed and with dorsal profile little elevated. Mouth small, terminal; jaws equal and armed with a single series of incisor teeth; vomer with a semicircular patch of similar teeth. Maxillary short, extending to vertical from anterior border of eye. Nape with an oblique patch and the eye with a smaller supraocular patch of filaments. Diameter of the eye slightly less than length of snout.

Scales cycloid, small, sixty-three in lateral line, head, breast, median line of belly, and bases of the ventral fins naked.

Dorsal fin long, beginning at nape and extending nearly to caudal fin. Spinous dorsal high anteriorly, notched between fourth and fifth spines and again between nineteenth and twentieth, the first spine high, one and three fourths diameter of eye and considerably longer than second spine; last spine about as high as third. Soft dorsal higher than the spinous, second ray highest, but little exceeding the other rays; last ray reaching two thirds the distance to caudal. Anal fin long, not extending quite as far posteriorly as dorsal, deeply incised; spinous portion short; soft part longer, the twelfth to the fourteenth rays longest. Pectorals rounded, rays fourteen, median longest. Caudal rounded, rays thirteen. Ventrals composed of three deeply incised rays.

Coloration in Life. — Above, light olive, sides with five broad olive-brown bands, breaking up ventrally into blotches, above the median line of the sides the dark bands separated by light purplish areas spotted with brownish, below the median line these areas become tawny-brown; head olive, rufous-blotched, opercle with a large circular dark blotch; underparts whitish, barred and spotted, the bars about as wide as the interspaces; branchiostegal membrane and throat very regularly barred; dorsal fin amber-yellow, with rufous spots and red-tipped spines and rays; pectoral membrane lighter, golden-yellow; rays rufous-spotted, lower dark red; ventrals whitish like belly, brown-barred, rays red-tipped; anal fin lemon with brown spots and red-tipped rays; caudal fin like dorsal in coloration; iris crimson.

This species is close to *M. delalandi* of the mainland from which it differs in the possession of more than twenty dorsal spines, in the higher first dorsal spine, and in the barred lower parts. We have examined twenty specimens of *M. delalandi* from Mazatlan, Mexico, and find the following variations in the fins; dorsal XIX–XX, 10–12; anal II, 18–19. Our Galapagos material gives the following formulæ:



Lepisoma jenkinsi

Dorsal fin,	XXI, 11	XXI, 11	XXII, 11	XXI, 10	XXI, 10	XXI, 11	XXI, 11	XXI, 11
Anal fin,	II, 20	II, 20	II, 20	II, 20	II, 18	II, 19	II, 20	II, 20
Scales in Lateral Line,	63	58	59	54	55	56	55	

The specimens in the collection are from Tagus and Iguana Coves, Albemarle Island.

MEASUREMENTS OF *Malacoctenus zonogaster*.

Length in mm	67	63	63
Head	28	28	27
Depth	29	26	31
Eye	8	8	7
Interorbital Width	4	35	4
Maxillary	9	9	9
Pectoral	27	26	27
Ventral	21	23	22
Height of Spinous Dorsal	14	14	14
Height of Soft Dorsal	16	17	15
Height of Anal	14	16	16
Caudal	21	21	24
Depth of Caudal Peduncle	9	8	9

LEPISOMA JENKINSI sp. nov.

Pl. XVI.

Type. — Cat. No. 6350 Leland Stanford Jr. University Museum. Iguana Cove, Albemarle Island.

Diagnosis. — Dorsal spines nineteen; interorbital width one and one half the diameter of eye; dorsal profile of head evenly rounded; scales large, fifty-six to sixty-one in lateral line. Color, above dark brownish-red with six blackish transverse bars on the sides; below light, spotted with red.

Description of the Type. — Head three and one third in length; depth three and one eighth; eye four and one half in head; maxillary two and one fifth; interorbital six and one fifth; D. XIX, 11; A. II, 18; pores 58.

General shape of body as in *L. xanti*, but the head higher with the dorsal profile more rounded and without an emargination at the nape. Mouth narrow, teeth anteriorly enlarged, the two lateral ones in front of the diastema recurved; vomer with a V-shaped patch of five teeth, the median one largest; vomerine teeth followed by two or three smaller palatine teeth on each side. Nuchal filaments well developed and much thicker than in *L. xanti*. Maxillary extending to vertical from middle of pupil. Interorbital wide, width one and two fifths diameter of eye.

Scales larger than in *L. xanti*, fifty-eight (pores) in lateral line, eight scales between base of the dorsal fin and curved anterior part of lateral line; below this point to middle line of belly are twenty-three vertical series of scales.

Dorsal fin long, notched before the last spine, spinous part low and slightly rounded, middle spines highest, two and five sixths in head. Soft dorsal much higher than spinous portion of fin, one and seven ninths in head; posterior rays reaching base of caudal fin. Pectoral fin rounded, middle rays longest, extending to vertical from second anal spine; rays fourteen. Ventral fin with three rays, the middle one longest, one and three fourths in length of head. Caudal fin rounded, twice the length of longest dorsal spine, rays thirteen.

Coloration in Life. — Above dark brownish-red, blotched and spotted with dusky; sides of the body with six broad, blackish transverse bars; ventral surface whitish with ruby-red spots; vertical fins like the sides; pectorals dark barred with red rays; ventrals light like the belly.

This species is closely related to *L. xanti* of the Pacific coast of Mexico, differing in the wider interorbital, the larger number of dorsal spines, the more rounded dorsal profile of the head and the darker and more reddish coloration. We have examined seven specimens of *L. xanti* from Mazatlan, Mexico, and La Paz, Lower California, and each of these possesses eighteen dorsal spines.

Secured only at Iguana Cove, Albemarle Island.

Named for Dr. Oliver P. Jenkins, of Stanford University.

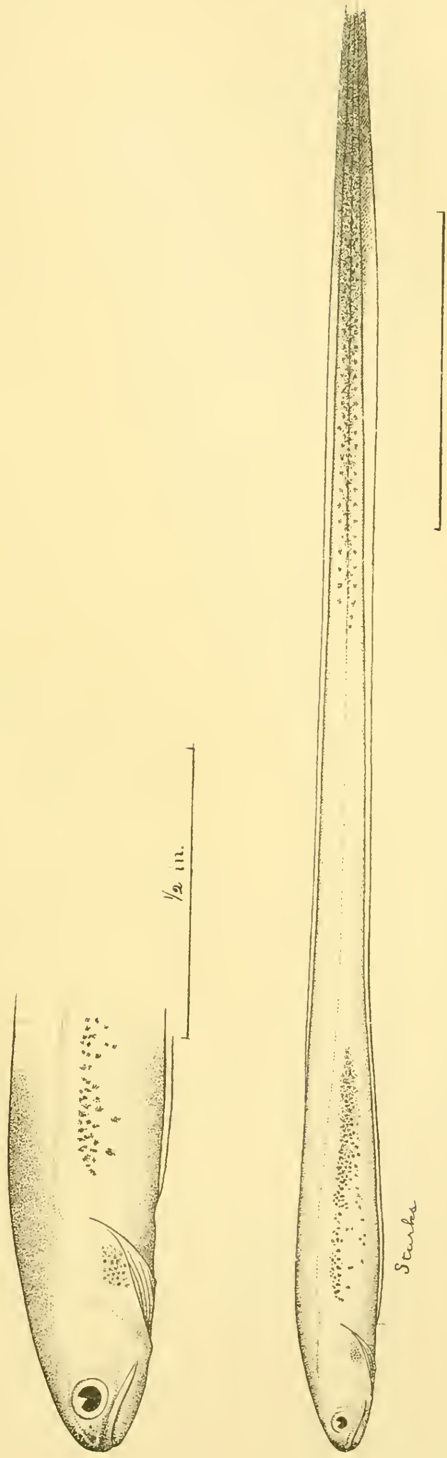
MEASUREMENTS OF *Lepisoma jenkinsi.*

Length in mm	95	85	92
Head	31	30	30
Depth	32	32	29
Eye	7	8	7
Snout	11	9	9
Maxillary	14	13	13
Interorbital Width	5	5	5
Height of Spinous Dorsal	11	12	11
Height of Soft Dorsal	17	17	16
Height of Soft Anal	16	15	16
Pectoral	28	27	26
Ventral	20	19	19
Caudal	22	20	21
Depth of Caudal Peduncle	10	10	9
Dorsal fin	XIX, 11	XIX, 11	XIX, 12
Anal fin	II, 18	II, 18	II, 17
Scales (pores)	58	61	59

ENCHELIOPHIS JORDANI sp. nov.

Pl. XVII.

Type. — Cat. No. 6345 Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.



Encheliophis jordani

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Diagnosis. — Body greatly attenuate, head twelve in length, depth seventeen in length; vertical fins confluent, low; dorsal fin beginning much behind the anal; teeth small, in a single series in each jaw and on the palatines; vomer with a rounded patch of larger teeth. Color, pinkish, the belly silvery and the tail bluish; belly, snout and body posteriorly spotted with brown.

Description of the Type. — Head twelve in the length; depth one and seven tenths in length of head; eye five and one fourth; maxillary two; interorbital five and one half; snout four and one half.

Body greatly attenuate, tapering very gradually from behind the head to the slender whip-like tail; not much compressed. Head long, depth one half the length; dorsal profile sloping gradually to bluntly rounded snout. Snout short, broad and rounded; occiput and interorbital regions convex or rounded. Mouth large, slightly oblique with included lower jaw, maxillary extending much behind eye. Teeth small, cardiform, in a single series in both jaws; palatines armed with a long series of somewhat larger teeth extending past angle of mouth; vomer with a small, rounded patch of teeth slightly larger than palatine series. Opercular bones without spines or free edges, the whole apparatus covered by the skin.

Gills four, a short slit behind the last, free from isthmus and united below the throat; no pseudobranchiæ. Gill-rakers short, few. Branchiostegal rays six. Gill openings ventral, narrow, the length two and one half in head.

Body naked; lateral line without evident pores, running high and following outline of back; beginning above opercle, extending forward on head to above eye, and posteriorly to slightly beyond body cavity. Vent situated below posterior border of opercle.

Vertical fins confluent; rays not evident; dorsal fin beginning behind snout a distance equal to three times length of head, the fin anteriorly very low, becoming higher posteriorly where equaling one third the eye in height. Anal fin beginning at vent, considerably higher than the dorsal, the height one half diameter of eye. Caudal fin and a few of the last vertebræ missing. Pectoral and ventral fins wanting.

Coloration in Life. — Head and body dusky-pink; the belly silvery, the tail grayish-lavender; iris greenish-gray.

Coloration in Alcohol. — Light brownish-yellow, the snout, belly and body, posteriorly finely spotted with dark brown. The spotting perhaps due to the dissolving out of the silvery pigment by the formalin in which the specimen was preserved, leaving the spots which were beneath it visible.

We have not seen Müller's figures of *E. vermicularis*, but his description is so meagre that the two species can be only approximately compared. The coloration is very different, there being in our specimen no trace of the blackish-brown color of the Philippine form.

Named for President David Starr Jordan of Stanford University.

The type was the only specimen taken.

MEASUREMENTS OF THE TYPE OF *Encheliophis jordani*.

Catalogue No. 6345 Leland Stanford Jr. University Museum.	
Length in mm	114
Length of Head in mm	10
Depth : Head	67
Eye : Head	19
Maxillary : Head	49
Interorbital : Head	18
Snout : Head	22
Height Dorsal : Head	6
Height Anal : Head	10

Petrotyx gen. nov.

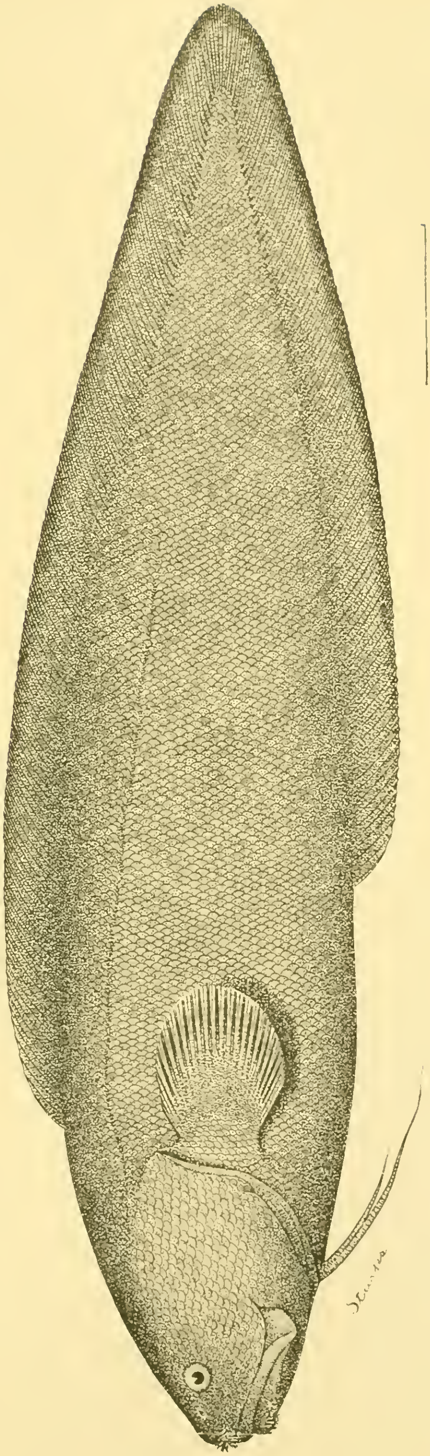
Characters. — Body not greatly attenuated or compressed; snout blunt, obtusely rounded; lower jaw included; teeth small, blunt; in broad bands in both jaws and on palatines; in a diamond-shaped patch on vomer; opercular bones without spines or sharp angles. Vertical fins long, united, caudal not differentiated; ventral composed of two rays, united for half their length. Snout and the tip of mandible with short thick cilia. Lateral line single, wanting posteriorly. Scales cycloid; present everywhere except on tips of the fins, margins of the jaws, and tip of snout. Gills four, a slit behind the last; gill-rakers few, short and thick, armed with minute teeth; pseudobranchiæ small. Branchiostegal rays eight. Head without evident muciferous canal openings. Air-bladder large, rounded posteriorly. Six pairs of pyloric cæca. Allied to *Catætyx*.

PETROTYX HOPKINSI sp. nov.

Pl. XVIII.

Type. — Cat. No. 6344 Leland Stanford Jr. University Museum. Barrington Island.

Diagnosis. — Head five times in length; depth slightly greater; maxillary long, extending much behind eye; eye small, eight times in head; gill-rakers short, stout, one + two; scales one hundred and thirty-five in a series from base of pectoral to end of last vertebra; dorsal rays one hundred and five; anal eighty-two; caudal ten; ven-



Petrotyx hopkinsi

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trals two, the height three fourths the head, filamentous at tip; pectorals short, fan-shaped, with broad bases.

Description of the Type. — Head five in length; depth four and four fifths; eye eight in head, interorbital four; snout three and three fifths; maxillary one and four fifths; D. 105; A. 82; C. 10; P. 24; V. 2; scales 11–135–38.

Vertical outline of body subfusiform, tapering from about the eighth dorsal ray; posteriorly compressed and attenuate to a point. Head broad and flat above with a furrow on each side of vertex running forward to above eye; sides of the head nearly vertical. Snout broad and bluntly rounded, tip formed by ciliated portion above premaxillary; mouth wide, horizontal, with included mandible; maxillary long, extending behind the anterior border of eye a distance equal to length of snout, only the posterior lower edge exposed. Teeth small and rather blunt, in broad close-set villiform bands in both jaws, the inner mandibular series slightly enlarged; arranged in an oblong patch on palatines and in a large diamond-shaped patch on vomer. Tip of the snout fringed with narrow or ligulate, ciliated flaps; the mandible with shorter similar cilia at its tip. Opercular bones without spines, their angles rounded. Head without evident muciferous canal openings. Gills four, a slit behind the last, free from the isthmus; pseudobranchiæ represented by six or seven short filaments; gill-rakers one+two, stout, club-shaped and shorter than the gill-filaments, armed with small teeth similar to those on the pharyngeal bones. Scales cycloid, covering entire body and head, absent only on premaxillary, maxillary, anterior portion of snout, margin of mandible, and tips of fins; exposed portion of the scales about one half diameter of eye in length. Lateral line slightly undulate, beginning above opercle, curving slightly and following outline of back, extending slightly beyond middle of dorsal fin; running between the scales, dorsal fin beginning slightly behind the base of pectoral; all the rays of about equal height, six and one third in head. Anal beginning at anus, equal to dorsal in height and similar to it in shape; caudal fin pointed, slightly longer than the height of the dorsal; not differentiated from vertical fins. Pectorals with wide bases, fan-shaped, the middle rays longest, length one and two thirds in head; ventral composed of two rays, united for half their length, filamentous at tip, outer ray the shorter, about three fourths the length of inner ray, which is one and one third in head. All the fins excepting the ventrals densely scaled to their tips, which are free and filamentous. Air-bladder large, oval, posteriorly broader and rounded, more pointed anteriorly; six pairs of pyloric cæca, the posterior one longest and equalling the snout in length.

Coloration in Life. — Dark reddish-brown, the head darker brown; vertical fins like the body, the tips maroon; pectorals with lighter edges; iris livid-bluish.

Named for Mr. Timothy Hopkins, of Menlo Park, California, to whose generosity the expedition is financially indebted.

MEASUREMENTS OF THE TYPE OF *Petrotyx hopkinsi.*

Catalogue No. 6344 Leland Stanford Jr. University Museum.	
Length in mm	217
Head	20
Depth	21
Eye	2.5
Interorbital Width	5
Snout	5.5
Maxillary	11
Height of Dorsal	6
Height of Anal	6
Pectoral	12
Ventral	15
Caudal	8
Snout to Dorsal	25
Snout to Anal	45

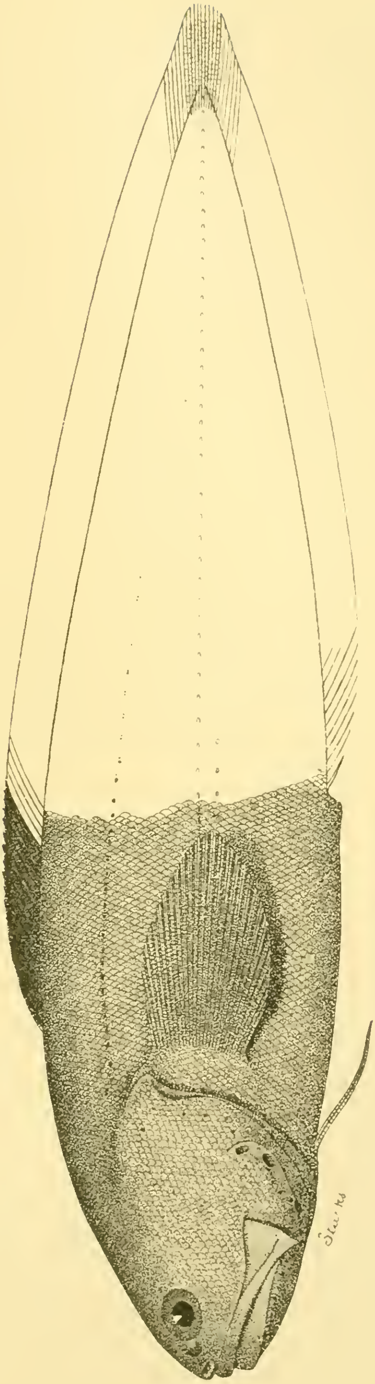
Eutyx gen. nov.

Characters. — Body comparatively short, compressed posteriorly; head broader, scarcely compressed, with a short rounded snout. Mouth large, with long maxillary; mandible included; teeth small, in villiform bands in both jaws and in a V-shaped patch on vomer; the inner mandibular series of teeth enlarged; palatines toothless; opercular bones without spines or sharp angles; head with prominent muciferous canal openings; lateral lines two on each side, overlapping for a fourth of their lengths; scales small, cycloid, embedded; present on body and opercles; head above naked. Gills four, a slit behind last; pseudobranchiæ wanting; gill-rakers few. Air-bladder moderately large, oblong, thick-walled; pyloric cæca consisting of two short sacs. Allied to *Grammonus* Gill, differing in the absence of opercular spines, and in the presence of the double lateral line and large muciferous canal openings on the head.

EUTYX DIAGRAMMUS sp. nov.

Pl. XIX.

Type.— Cat. No. 6346 Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.



Eutyx diagrammus

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Diagnosis.—Head four times in length; depth slightly less; mandible with slightly enlarged teeth; opercular bones without spines; lateral line double for a fourth of its length; scales one hundred and twenty-two; dorsal fin long, beginning posterior to base of pectorals, rays one hundred and six; anal eighty-nine; pectorals twenty-seven. Color, uniform dark brown.

Description of the Type.—Head four in length; depth four and one sixth; eye five and one half in head; snout three and five sevenths; interorbital four and one fourth; maxillary one and two thirds; D. 106; A. 89; P. 27; C. 10; scales 14–122–35; pores $\frac{30}{40}$.

Vertical profile of body elliptical, dorsal and ventral outlines subequal; body compressed and tapering to a point posteriorly. Head large and rounded over vertex, dorsal profile converging sharply toward the short, bluntly rounded snout; interorbital region convex. Mouth large, with a long maxillary, extending behind eye a distance equal to length of snout; cleft slightly oblique; mandible included; teeth small, in villiform bands in both jaws; the inner mandibular series enlarged and consisting of about twenty large, spaced teeth, the posterior largest; vomer with a V-shaped patch of small teeth; palatines toothless; opercular bones without prominent angles or spines, their posterior edges covered with scales; preopercle bordered below angle by a naked groove containing three large mucous canal openings. Tip of the snout and mandible with a pair of mucous canal openings; upper part of the opercular membrane with a similar opening. Gills four, a long slit behind last, free from the isthmus; pseudobranchiæ wanting. Gill-rakers few, 0+3, short, club-shaped, length of longest one third diameter of eye, armed with minute teeth. Scales small, cycloid, embedded, covering body and opercle above angle of preopercle; head above, snout, mandible and fin membranes naked; scales on one side of the head deeply embedded and hidden beneath the skin. Lateral lines two, the upper beginning above opercle and extending to below middle of dorsal fin, following outline of back; the lower line median, beginning slightly before anus and extending horizontally to last vertebra; the lines double for one fourth of their length; pores thirty on upper line and forty on lower. A few pores below and running parallel with lower line. Lateral line extending on head from angle of opercle obliquely downward to tip of mandible.

Dorsal fin long, extending from base of pectorals to the undifferentiated caudal fin with which it is merged; rays of about equal height throughout, the anterior slightly shorter; height of median rays three and one half in head; all the rays free at the tip and somewhat filamentous. Anal fin beginning at anus, similar in shape to dorsal which it equals in height. Caudal fin not differentiated from dorsal or anal fins, but slightly longer than these, two and two thirds in head. Pectorals with broad bases, pointed, extending to vertical from anus. Ventrals attached slightly posterior to isthmus, composed of two rays united their whole length, extending half-way to anus. Pyloric cæca two short, thick, sac-like projections about equaling the diameter of eye in length.

Coloration in Life. — Dark brown, head purplish-brown; fins blackish.

A smaller specimen taken at the Seymour Islands varies somewhat from the *type* in the possession of longer fins and uniform purplish-brown coloration. Both specimens taken in about three fathoms.

MEASUREMENTS OF *Eutyx diagrammus*.

Length in mm	87	53
Head	25	27
Depth	24	24
Eye	4.5	4.5
Interorbital Width	6	5
Snout	7	7
Maxillary	15	15
Height of Dorsal	7	8
Height of Anal	7	8
Pectorals	16	18
Ventrals	15	17
Caudal	9	11
Snout to Dorsal,	32	33
Snout to Anal	49	46

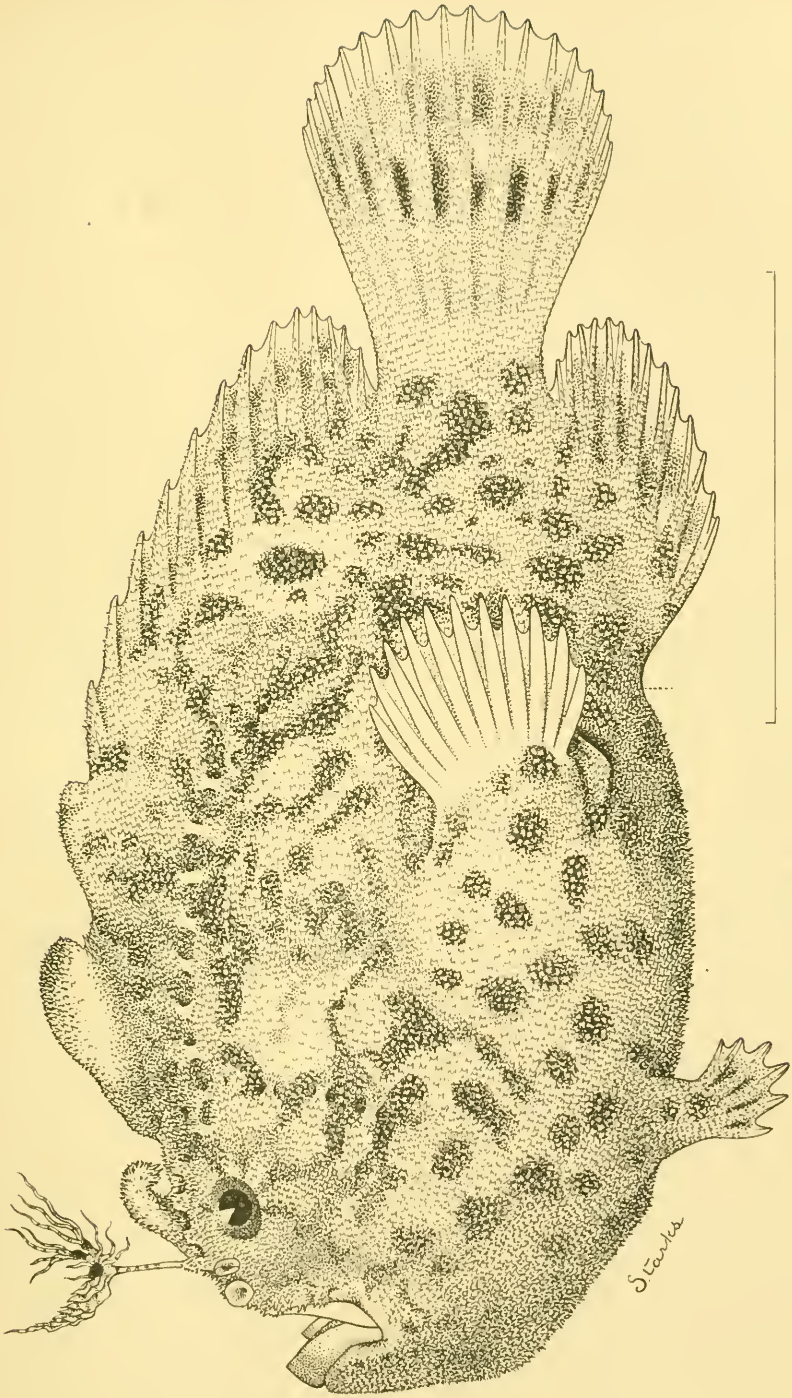
ANTENNARIUS TAGUS sp. nov.

Pl. XX.

Type. — Cat. No. 6351 Leland Stanford Jr. University Museum. Tagus Cove, Albemarle Island.

Diagnosis. — First dorsal spine slender, terminated by a bifid cluster of long filaments; second spine curved downward at tip; D. III, 13. Head without fleshy flaps; gill-opening below and slightly posterior to pectoral; body and head covered with bifid spinules. Color, light pinkish and yellowish, dark-spotted, without ocelli.

Description of the Type. — Head two and one third in length; depth one and nine tenths; eye seven in head; maxillary one and four fifths; interorbital three and one third; D. III, 13; A. 7; P. 11; C. 9; V. 5



Antennarius tagus

General shape much as in *A. ocellatus;* body compressed posteriorly; breast and lower jaw tumid; head wide, the width one and one third in length; mouth dorsal with the cleft vertical and the mandible armed at the symphysis with a knob, projecting beyond the premaxillary; mandible long, one and three fourths in head, naked, the posterior one third hidden beneath a deep fold of the skin; teeth small, in villiform bands in both jaws, and on vomer and palatines; head without large fleshy filaments about angle of mouth and mandible; gill-openings small, without naked areas surrounding them; situated below and slightly posterior to waist; head, body, fin-rays and spines armed with small bifid spinules, lacking only on premaxillary, maxillary, margin of mandible, first dorsal spine, depression behind second dorsal spine, five supraocular pits, fin membranes and on underside of pectoral and ventral rays; spinules widely forked, with a small tentacle, exceeding the spines in length, between each two; first dorsal spine slender, filamentous, terminated by a cluster of long filaments which are arranged in two more or less distinct clusters. Filaments more than two thirds the length of stalk, which is slightly shorter than second dorsal spine; second dorsal spine thickened, low, curved downward at apex, followed by a deep, smooth depression; third dorsal spine higher and heavier, membrane deeply incised in front of the soft dorsal; soft dorsal subrounded, much higher than spinous part, ninth and tenth rays highest, exceeding slightly the maxillary; first ray short, truncate at tip, posterior rays reaching beyond base of caudal; anal fin similar to soft dorsal, but more rounded and slightly lower; pectoral fin geniculate, subrounded, some of upper rays longest, one and two fifths in head; ventrals rounded, one half length of pectorals, situated below posterior border of eye; inner ray divided; caudal evenly rounded at tip, rays all divided, length slightly less than pectorals.

Coloration in Life. — Above pinkish or flesh-color, spotted and streaked with light and dark olive-brown; a small unspotted area above pectoral, below creamy with dark olive-brown spots; chin and snout faintly dark spotted; orbit below and posteriorly with radiating dark streaks; first dorsal spine light with dusky cross bars, second and third spines without dark spots; soft dorsal spotted like back, anal fin similar; pectoral and ventral fins immaculate below, dusky, dark spotted above; caudal fin with two series of dark spots on membrane running vertically through fin; iris light golden-brown.

This species is nearest to *A. ocellatus*, differing in the coloration, the bifid filaments of the first dorsal, and the lack of dermal flaps on the head, at the angle of the mouth and on the mandible.

MEASUREMENTS OF THE TYPE OF *Antennarius tagus.*

Catalogue No. 6351 Leland Stanford Jr. University Museum.	
Length in mm	58
Depth	53
Head	43
Width of Head	36
Eye	6
Interorbital Width	13
Maxillary	25
Height of First Dorsal Spine	9
Height of Second Dorsal Spine	10
Height of Soft Dorsal	26
Height of Anal	24
Pectoral from Gill-opening	31
Ventral	18
Caudal	30

Genus **Allector** gen. nov.

Characters. — Body short, stout, and not much compressed; head large, cuboidal, armed with a pair of stout supraorbital spines; mouth large, vertical in position, premaxillary and mandible armed with canine teeth; vomer and palatines toothless; soft dorsal and anal fins with bases short, posterior in position; pectorals geniculate; ventrals wanting.

ALLECTOR CHELONIÆ sp. nov.

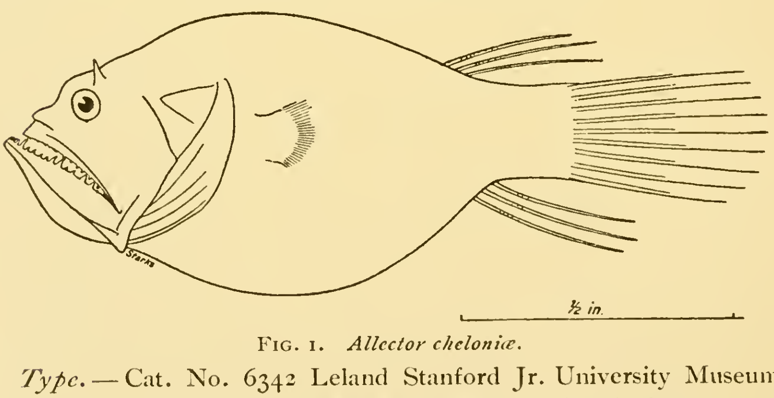


FIG. 1. *Allector cheloniæ.*

Type. — Cat. No. 6342 Leland Stanford Jr. University Museum. Taken between Clipperton Island and Galapagos Archipelago.

Diagnosis. — Head large, two and three sevenths in total length, broad and flattened above, with a pair of supraorbital spines; teeth in both jaws irregular, not greatly enlarged, longest equaling diameter of pupil; vertical fins filamentous at tip; D. 3; A. 3; C. 9; P. 18.

Description of the Type. — Head two and three sevenths in length; depth two and two thirds; eye contained seven times in length of head;

interorbital two and one half; maxillary one and two thirds; mandible one and one half; D. 3; A. 3; C. 9; P. 18.

Head large and cuboidal, broad and flat above with vertical sides, terminated squarely anteriorly by the vertically placed mandible; mouth large, the cleft exceeding one half the head in length. Upper jaw margined by the premaxillary, which is armed with a single series of irregular teeth somewhat smaller than the mandibular teeth; length of the maxillary one and two thirds the length of head. Mandible toothed its whole length with a single series of large, irregular, sharp, canine teeth which are slightly compressed at their bases, length of longest teeth about equaling diameter of pupil; mandible with a prominent projection at its posterior end. Eye comparatively large, diameter contained three times in interorbital width. Head armed above by a pair of short, stout, horn-shaped spines situated above and behind the eye; branchiostegal rays five.

Body short, more or less compressed and tapering slightly to the thick peduncle; dorsal fin short, consisting of three rays, situated a little in advance of base of caudal fin, rays filamentous at tip, reaching past base of caudal, length one and two thirds in head. Anal fin similar to dorsal in shape and composed of same number of rays, first ray situated slightly behind last dorsal ray, somewhat longer than dorsal, longest rays reaching past middle of caudal fin. Caudal long with filamentous rays, truncate or slightly rounded. Pectorals short, turned forward, rounded, contained three times in length of head.

The specimen was taken from the stomach of a green-turtle, and the skin is all gone from the body. The flesh is whitish, the exposed bones brownish and the iris bluish-silvery. There is no indication of a spinous dorsal, not even of the basal elements of one.

MEASUREMENTS OF THE TYPE OF *Allector cheloniæ*.

Catalogue No. 6342 Leland Stanford Jr. University Museum.	
Length in mm	27
Head	42
Depth	37
Eye	6
Interorbital Width	17
Premaxillary and Maxillary	26
Mandible	28
Height of Dorsal	25
Height of Anal	28
Pectoral	14
Caudal	30
Depth of Caudal Peduncle	16

PROCEEDINGS

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PAPERS FROM THE HOPKINS-STANFORD GALAPAGOS EXPEDITION, 1898–1899.

XVI.

BIRDS.

By Robert Evans Snodgrass and Edmund Heller.

CONTENTS.

INTRODUCTION.

The succession of families and genera followed in this paper is that of the American Ornithologists' Union. Trinomials are applied according to A. O. U. canons of nomenclature, *i. e.*, when forms overlap in their variations, regardless of the possibility or impossibility of their interbreeding, they are called subspecies. A number is given to each species of a genus, and this number is intended to stand, not for the form first named, but for the sum of all the subspecies, where subspecies that compose the species occur, not this number and a letter for each of the other subspecies as in the A. O. U. Check List. Each variety of a species is lettered. Thus: 63, *Geospiza fortis* consists of 63*a*, *G. fortis fortis*; 63*b*, *G. fortis fratercula*, etc.; not 63, *Geospiza fortis*; 63*a*, *G. fortis fratercula*, etc.

Subspecies are arranged in the order of their apparent relationships, not according to priority of description.

All measurements, unless otherwise stated, are in millimeters. Measurements of length are in all cases of the specimen before being skinned.

Family SPHENICIDÆ.

Genus Spheniscus Brisson.

Spheniscus BRISSON, Ornithologist, VI, p. 96, 1760.

Range. — Antarctic regions, southern parts of South America and Africa, and the Galapagos Archipelago.

1. SPHENISCUS MENDICULUS Sundevall.

Spheniscus mendiculus SUNDEVALL, Proc. Zool. Soc. Lond., pp. 126, 129, 1871 (James Island, Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 660, 1896.—ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 199, 1899.

Range. — Galapagos Archipelago: Charles, Seymour, James, Duncan, Albemarle and Narboro.

This species is most common at Tagus and Iguana Coves on Albemarle, about Narboro, and on the east side of the Seymour Islands. It probably seldom if ever occurs at the more northern islands of the group — Abingdon, Bindloe, Tower, Wenman and Culpepper. We did not see it at any of these islands or at Chatham or Barrington. Captain Noyes told us that he once saw one at Wenman Island. If so this is the only record of the occurrence of the family north of the equator, Wenman Island lying in 1°20′ N.

The species is said to be closest to *S. magellanicus* of the southern part of South America, ranging northward to southern Chile on the west, to Rio Grande do Sul on the east, and inhabiting the Falkland Islands and South Georgia. It differs from this species in being smaller and in having a longer and more slender bill.

We have four specimens from Tagus Cove, all of them having a pale brownish-gray inner margin to the dorsal edge of the wings. The skin about the bill is pinkish-purple; the upper mandible black, yellow at the base, and with a light spot on the side before the nostril; lower mandible black on the distal third, the rest pale yellowish.

The birds sit most of the time on the rocks near the shore, from which, when disturbed, they simply drop off into the water. When sitting in an upright attitude the body is for the most part held perpendicular, but it is bent forward somewhat at the middle of the spine, giving the bird a sort of humpbacked appearance. The wings are suspended at the sides, but held a little away from the body so that from a distance one can see between the wings and the body. When sitting in a horizontal attitude, as they do when evidently taking their ease, generally on the top of some rock, the same hump is conspicuous at the middle of the back, the wings are held downward at right angles to the body, clasping the sides of the rock as if to help retain the position there. The wings are never held back against the sides of the body in ordinary bird fashion. The bill is nearly always directed upward at a small angle. During progression on land they hop with both feet together, keeping the body erect, and present a very awkward and clumsy appearance; but in the water they are exceedingly graceful. When quietly floating the bill is inclined a little upward as when they sit on the rocks. They swim entirely by means of the wings, the feet being held close together and extended straight behind the body, acting apparently as a rudder. On the surface they swim rather slowly, and an up-and-down bobbing motion is imparted to the body. Beneath the surface they go in any direction with great rapidity, having then more the appearance of a fish or seal than of a bird. They also leap from beneath the water into the air and dive back again just as does a seal or porpoise when breaching.

Occasionally they make a sort of grunt, and also utter deep elongated sounds resembling *hă-ă-ă-ăh*, the stress gradually declining toward the end. This latter note seems to be a call from one bird to another, but when uttered no obvious reason appears why they should thus call to one another. We did not find them nesting and did not see any of them mated.

Family STERCORARIIDÆ.

Genus **Stercorarius** Brisson.

Stercorarius BRISSON, Ornithologist, VI, pp. 149, 150, 1760.

Range. — Breeding in arctic and subarctic regions, migrating in winter south into the tropics.

2. STERCORARIUS POMARINUS (Temminck).

Lestris pomarina TEMMINCK, Manuel d'Ornithologie, p. 514, 1815.
Stercorarius pomarinus ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 192, 1899 (Galapagos).

Range. — Nearctic and palæarctic, south in winter to Africa, Australia and South America. Galapagos Archipelego (accidental).

One immature female reported by Rothschild and Hartert, taken by the Harris expedition in December.

Family LARIDÆ.

Genus **Larus** Linnæus.

Larus LINNÆUS, Syst. Nat., ed. x, I, p. 136, 1758.

Range. — Cosmopolitan. Galapagos Archipelago.

3. LARUS FULIGINOSUS Gould.

Larus fuliginosus GOULD, Zool. Voy. Beagle, III, Birds, p. 141, 1841 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, 1896, p. 635. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 189, 1899.

Range. — Galapagos Archipelago: Chatham, Hood, Charles, Barrington, Indefatigable, James, Albemarle, Narboro, Abingdon, Bindloe and Tower. Common about nearly all the islands except Wenman and Culpepper where it appears to be absent. We have four specimens taken at Tagus Cove, Albemarle, in January.

They are extremely noisy birds. When one is about to alight to feed, whether alone or with others, it begins to utter harsh, elongated sounds repeated in quick succession and long continued. Often, when uttering the notes, the bird stands with the foreward part of the body depressed. Often also, they utter a sound composed of a monotonous series of closely repeated guttural notes resembling *äh äh äh äh äh äh äh*. There is never any apparent reason why they should utter these sounds.

4. LARUS FRANKLINII Swainson and Richardson.

Larus franklinii SWAINSON AND RICHARDSON, Faun. Bor. Amer., II, p. 424, pl. 71, 1831.

Range. — Interior of western North America, south in winter to South America; Galapagos (accidental).

We have one specimen, an immature male, taken at Mangrove Point, Narboro, in March. This is the only record of the species from the Galapagos, though it is said to be plentiful in winter on the coast of Ecuador and Peru.

Genus **Creagrus** Bonaparte.

Creagrus BONAPARTE, Naumannia, p. 211, 1854.

Range. — Galapagos Archipelago, coast of Peru, Malpelo Island.

5. CREAGRUS FURCATUS (Néboux).

Larus furcatus NÉBOUX, Rev. Zool., p. 290, 1840; Voy. Venus, Atlas, pl. x, 1846 ("Monterey, California" — probably a mistake).
Creagrus furcatus SALVIN, Trans. Zool. Soc., IX, p. 506, 1876 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 638, 1896.
Xema urcata ROTHSCHILD AND HARTERT, Novit. Zool, VI, p. 190, 1899.

Range. — Galapagos Archipelago: Chatham, Hood, Seymour, James, Albemarle, Narboro, Tower, Wenman and Culpepper. Coast of Peru and Malpelo Island.

This species was first reported by the *Venus* from Monterey, California. Presumably this is a mistake through confusion of labels, for on the same cruise the *Venus* collected at the Galapagos and should have gotten the gull there where it is abundant.

It is a common bird of the Galapagos, frequenting nearly all the islands. We found it in December specially abundant at Wenman and Culpepper. Large numbers of these birds were nesting on the cliffs of the small islet lying near the main island of Wenman. Apparently they nest only on the cliffs, for none was found on the upper surface of the island where many boobies and frigate birds were nesting. It is an extremely noisy species. As the birds sit on the cliffs they utter shrill elongated notes having a sort of weary tone to them. They often vary this sound by breaking up the first or the last part into a series of closely connected chattering notes. At other times they open the mouth widely and make a harsh guttural sound, consisting of one note repeated several times in quick succession. This sound differs from the reiterated one accompanying the continuous notes in being much less guttural and in having a flatter tone and a pitch about the same as the continuous shrill part. The birds utter some or all of these sounds almost continually, and when many are together they make a great deal of noise. They utter the same notes while flying.

The bird lays a single egg on a ledge of the cliff, constructing no nest. Two specimens of eggs have a light yellowish-brown ground color, and are blotched with a few large purplish-brown paler spots, and darker, smaller ones of dark brown. The markings are evenly scattered about over the surface, and are much more numerous on one than on the other. In shape they are ovate and measure 65×48 and 68×45.

We were at Albemarle Island from January 1 till January 20 before we saw any individuals of this species. On the latter date we took one at Tagus Cove; after this we saw several here every day, and in February they became common.

We have four specimens from Culpepper, Wenman and Albemarle.

Genus **Sterna** Linnæus.

Sterna LINNÆUS, Syst. Nat., ed. x, 1, p. 137, 1758.

Range. — Cosmopolitan. Galapagos Archipelago.

6. STERNA FULIGINOSA Gmelin.

Sterna fulginosa GMELIN, Syst. Nat., I, p. 605, 1788. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 191, 1899 (Culpepper and Wenman Islands, Galapagos).

Range. — Tropical and subtropical shores everywhere. In the eastern Pacific: Revillagigedo, Clipperton and Cocos Islands, west coast of Mexico, west coast of South America, Galapagos Archipelago.

Reported by Rothschild and Hartert as taken by the Harris expedition at Wenman and Culpepper. We observed it at these islands in December, but did not secure any specimens.

Genus **Anous** Stephens.

Anous STEPHENS in Shaw's Gen. Zool., XIII, p. 139, 1826.

Range. — Intertropical. Galapagos Islands.

7. ANOUS STOLIDUS GALAPAGENSIS (Sharpe).

Megalopterus stolidus GOULD, Zool. Voy. Beagle, III, Birds, p. 146, 1841 (Galapagos).

Anous galapagensis SHARPE, Phil. Trans., CLXVIII, p. 469, 1879 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 642, 1896.

Anous stolidus galapagensis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 191, 1899.

Range. — Galapagos Archipelago: Charles, Hood, Chatham, Barrington, Seymour, Duncan, James, Albemarle, Narboro, Abingdon, Bindloe, Tower, Wenman and Culpepper.

This is a very abundant species throughout the archipelago. It is very similar to *A. stolidus ridgwayi* Anthony of Cocos and Clipperton Islands, but differs from this subspecies in being slightly darker and in having a more dusky tone to the back and upper tail coverts, and also in having the gray of the upper part of the head darker. One of the Cocos specimens in our collection, however, has the tone of this color indistinguishable from that of the Galapagos specimens. The under parts also of *A. s. galapagensis* are darker, having a more dusky shade.

Our collection contains three adult males and two adult females, all taken in January.

At Tagus Cove, Albemarle, these birds were very abundant about the high cliffs facing the ocean. They began to mate about January 21 and on the first of February we found eggs. Each bird lays a single egg. The nests were placed in holes in the faces of the tufa cliffs about the cove, and were often so low that they could be reached from a boat. The nest was in all cases a scant affair, consisting of a few twigs laid in the bottom of the cavity. The eggs are slightly elongate-ovate. The color is creamy white, marked with a few small light and dark blotches of brown, most numerous about the large end; one egg having the rest of the surface almost plain. Two specimens measure: 50 × 34 and 48 × 35. We found them nesting on James Island in April.

Family DIOMEDEIDÆ.

Genus **Diomedea** Linnæus.

Diomedea LINNÆUS, Syst. Nat., ed. x, I, p. 132, 1758.

Range. — Entire Pacific Ocean and southern seas in general. Galapagos Archipelago.

8. DIOMEDEA IRRORATA Salvin.

Diomedea exulans WOLF, Ein Besuch auf den Galapagos Inseln, p. 13, 1879.
Two kinds of Albatrosses HABEL, Trans. Zool. Soc. Lond., IX, p. 458, 1876.
Diomedea exulans and *D. nigripes* RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 646, 1896.
Diomedea irrorata SALVIN, Proc. Zool. Soc. Lond., p. 430, 1883 (Callao, Peru); Cat. Birds Brit. Mus., XXV, p. 445, pl. 8, 1896. — ROTHSCHILD, Bull. Brit. Ornith. Club, VII, p. 51, 1898. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 192, 1899.

Range. — Galapagos Archipelago and coast of Peru. The home of this species appears to be restricted to the eastern end of Hood Island. Albatrosses have long been known to exist at the Galapagos Islands, but the specimens brought back by the Harris expedition in 1898 were the first to be certainly identified. They were determined by Rothschild and Hartert to be *Diomedea irrorata*, a species described in 1883 by Salvin from a specimen taken at Callao, Peru, evidently a wanderer from the Galapagos, for no others have been taken on the mainland.

Albatrosses are frequently to be seen among the islands of the archipelago, but they breed only at the eastern end of Hood Island. There is here a large rookery which has long been known to whalers and made to supply eggs for eating. At the time of our visit to Hood Island in May the albatrosses were nesting. The nests were scattered about on the ground in open places among the bushes, averaging about twenty-five feet apart. A few of the birds were in pairs, apparently not yet nesting; but most of them were sitting on one egg each. When disturbed they attempted to frighten away the intruder by loudly snapping the beak.

We have seven eggs taken in May. They are somewhat elongate-ovate, not much narrowed at the smaller end. The ground color is dull whitish; the surface is finely speckled with cinnamon color, sometimes sparsely spotted about the larger end with small brown blotches, but generally with a dark cap at the larger end of closely speckled brown, extending for a varying distance toward the smaller end of the egg, but always disappearing at one third of the distance, often narrowly confined at the end. They measure 111 × 74; 112 × 74, 108 × 72; 113 × 71; 112 × 74; 10 × 569; 113 × 72.

Family PROCELLARIIDÆ.

Genus **Puffinus** Brisson.

Puffinus BRISSON, Ornithologist, VI, p. 131, 1760.

Range. — Cosmopolitan. Galapagos Archipelago.

9. PUFFINUS OBSCURUS SUBALARIS (Ridgway).

Puffinus tenebrosus? TOWNSEND, Proc. U. S. Nat. Mus., XIII, p. 142, 1890 (Galapagos).
Puffinus tenebrosus TOWNSEND, Bull. Mus. Comp. Zool., XXVII, No. 3, p. 126, 1895 (Galapagos).
Puffinus subalaris RIDGWAY (from Townsend's MS.), Proc. U. S. Nat. Mus., XIX, p. 650, 1896 (Galapagos).
Puffinus obscurus subalaris ROTHSCHILD AND HARTERT, Novit. Zool., VI, 1899, pp. 194, 1895.

Range. — Galapagos Archipelago.

We quote the name of this form as a subspecies of *Puffinus obscurus* from Rothschild and Hartert, having no material with which to make comparisons.

The bird is common about the Galapagos Islands, but it does not appear to breed at many places. At Wenman it was common in December, and was found on the main island in a cave near the south end of the east shore. In the cave the birds were rather timid and sought the darker parts of it when approached. When disturbed while sitting on the floor and on ledges of the walls, they made no resistance but simply got out of the way of the intruder by retreating farther back into the cave or beneath loose rocks. They could not be driven out. One bird was found here sitting on an egg which she could not be made to leave, although she only passively resisted its being taken by remaining motionless upon it. The egg was deposited upon the bare ground near the wall of the cave. It is plain white, somewhat elongate-ovate, and measures 52 × 35.

We have three adult male and three adult female specimens taken in December and January.

Genus **Æstrelata** Bonaparte.

Æstrelata BONAPARTE, Consp. Av., II, p. 188, 1856.

Range. — Cosmopolitan. Galapagos Archipelago.

10. ÆSTRELATA PHÆOPYGIA Salvin.

Æstrelata phæopygia SALVIN, Trans. Zool. Soc. Lond., IX, p. 507, 1876 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 648, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 198, 1899.

Range. — Galapagos Islands.

We did not meet with this species about the archipelago until March 4. After this it became a very frequent bird, but nowhere did we find it breeding.

We have four specimens from off Iguana Cove, Albemarle, two taken in March and two in June. The bill is black, the tarsus and the basal third of the toes livid whitish, the rest of the toes and the claws black.

MEASUREMENTS OF ADULT SPECIMENS OF *Æstrelata phæopygia*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Depth of Bill at Base.	Width of Bill at Base.	Tarsus.	Middle Toe.
4309	Albemarle	♂	415	284	155	34	25	15	14	37	45
5097	"	♀	405	295	143	34	24.5	16	15	38	45
5091	"	"	400	285	150	33	24.5	15	15	36	43
4317	"	"	408	295	157	33	24.5	15	14	37	41

Genus **Procellaria** Linnæus.

Procellaria LINNÆUS, Syst. Nat., ed. X, I, p. 131, 1758.

Range. — Cosmopolitan. Galapagos Archipelago.

11. PROCELLARIA TETHYS Bonaparte.

Procellaria tethys BONAPARTE, J. f. Orn., p. 47, 1853; Compt. Rend., XXXVIII, p. 662, 1854 (Galapagos). — TOWNSEND, Bull. Mus. Comp. Zool., XXVII, No. 3, p. 126, 1895 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 656, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 199, 1899.

Range. — Galapagos Archipelago, Cocos Island and neighboring waters. This bird is to be found throughout the archipelago, but is specially abundant about Iguana Cove at the southern end of Albemarle and at Mangrove Point, Narboro. Townsend reports it from four hundred miles east of the Galapagos and we observed it north of the Galapagos Islands in the latitude of Cocos Island.

We have ten specimens taken at Iguana Cove, Albemarle and Mangrove Point, Narboro, in December and April.

Genus **Oceanodroma** Reichenbach.

Oceanodroma REICHENBACH, Syst. Av., p. 4, 1852.

Range. — Cosmopolitan. Galapagos Archipelago.

12. OCEANODROMA CRYPTOLEUCURA (Ridgway).

Cymochorea cryptoleucura RIDGWAY, Proc. U. S. Nat. Mus., IV, p. 337, 1882 (Hawaiian Islands).
Oceanodroma cryptoleucura TOWNSEND, Bull. Mus. Comp. Zool., XXVII, p. 125, 1895 (Wenman Island, Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 654, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 198, 1899.

Range. — Hawaiian and Galapagos Islands in the Pacific, St. Helena, Madeira and Cape Verde Islands in the Atlantic.

We have no specimens of this species. It has been taken at the Galapagos Islands only by Townsend.

Genus **Oceanites** Keys. and Blas.

Oceanites KEYSERLING AND BLASIUS, Wirblth. Europ., I, p. xciii, 1840.

Range. — Cosmopolitan. Galapagos Archipelago.

13. OCEANITES GRACILIS (Elliott).

Thalassadroma gracilis ELLIOTT, Ibis, p. 391, 1859 (west coast of South America).
Oceanites gracilis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 658, 1896 (Galapagos). — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 198, 1899.

Range. — Coast of Chile and the Galapagos Archipelago.

We have eleven specimens taken at Iguana Cove and Tagus Cove, Albemarle, in December and January. The species occurs at nearly all of the islands, but nowhere did we find it breeding.

Family **PHAËTHONTIDÆ.**

Genus **Phaethon** Linnæus.

Phaëthon LINNÆUS, Syst. Nat., ed. x, I, p. 134, 1758.

Range. — Intertropical seas. Galapagos Archipelago.

14. PHAËTHON ÆTHEREUS Linnæus.

Phaëthon æthereus LINNÆUS, Syst. Nat., ed. x, I, p. 134, 1758. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 600, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 180, 1899.

Range. — Tropical seas in general.

We observed this species all the way from Guadalupe Island off Lower California to the Galapagos Archipelago. At the latter locality we found it most abundant at Wenman, Culpepper, Hood and Brattle, but nowhere did we find it nesting. The Harris expedition report it as nesting on the eastern end of Hood Island in October.

This is the only species of *Phaëthon* that has been observed at the Galapagos Islands, although *P. rubicaudus* is rather common in the eastern Pacific north of the Galapagos.

Family SULIDÆ.

Genus Sula Brisson.

Sula BRISSON, Ornithologist, VI, p. 495, 1760.

Range. — Temperate and tropical seas.

15. SULA VARIEGATA Tschudi.

Dysporus variegatus TSCHUDI, Fauna Peruana, Ornithologist, p. 313, 1845 (Peru).
Sula cyanops RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 595, 1896 (Galapagos — quoted from Sundevall).
Sula variegata ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 178, 1899.

Range. — Coasts of Chile and Peru. Galapagos Archipelago: Culpepper, Wenman, Tower, James, Brattle, Charles and Hood.

This species is common on the most northern and most southern islands of the Archipelago — Wenman, Culpepper, Tower and Hood — but seldom visits the central islands. We never saw it at Tagus Cove, Albemarle, where we spent several months, and at Elizabeth Bay, Albemarle, we saw only a few in February flying over Perry Isthmus which separates the northern half of Albemarle Island from the southern half.

The coloration in life of the naked parts of the adults is as follows: Bill light orange-red, yellowish at the tip and along the commissure; skin about the eyes deep greenish-black, a light spot beneath the eye; gular sac blackish.

On Culpepper this species was found on the tenth of December just beginning to nest. A few birds were seen sitting on eggs, but most of them were in pairs defending nesting sites. The nests consisted merely of slight depressions scraped in the soil.

On Wenman this *Sula* was very abundant and the nesting season here, from the thirteenth to the twenty first of December, was somewhat more advanced than we found it on Culpepper Island. The birds were nesting in considerable numbers on the small, flat topped island lying to the north of the main island. There is no soil on this island and the females deposited their eggs on the flat surface of the rocks. We did not see any nesting on the ledges of the low cliffs forming the sides of the island. No nest is constructed, and generally only one egg is laid by each female. On Culpepper we saw some nests containing two. They snap their beaks viciously at the foot or leg of the intruding person, and a nesting bird cannot be forced to leave her egg. Even those that are not nesting can scarcely be made to fly. The birds are extremely noisy. When approached they utter loud, harsh, squawking sounds, which become louder and more rapid the more they are disturbed. They utter also a sort of whistling sound made apparently in the lower part of the throat while the mouth is held wide open. This whistle is generally preceded by a blowing sound. Birds with eggs make no sounds different from those made by others. One bird when annoyed by poking it with a stick uttered only the loud squawking, while another, disturbed in the same manner, uttered only the whistling notes and could not be induced to make any other sound. Generally, however, the same bird made both of the sounds, changing at short intervals from one to the other. The squawking sound is the one most commonly uttered.

MEASUREMENTS OF ADULT SPECIMENS OF *Sula variegata*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Depth of Bill at Base.	Tarsus.	Middle Toe.
3835	Culpepper.	♂	830	430	230	101	43	53	83
3837	"		880	455	233	111	41	55	80
3838	"	♀	860	450	220	106	39	55	78
3839	"		855	452	220	109	41	54	83
3877	Wenman.	♂	805	450	230	100	42	56	78
3839	"	♀	845	448	230	103	43	53	77
4136	"		800	430	225	101	43	54	77

A bird just out of the egg and not yet having its eyes open, was observed lying squirming on the ground, uttering in slow succession low chuckling notes. There was no apparent reason why it should be making these sounds.

Two sets of two eggs each were taken on Culpepper. In color they are like those of other species of *Sula*. They measure 65 × 46, 62 × 44, and 70 × 44, 70 × 46.

We did not find this *Sula* nesting on Tower when this island was visited in June. A few of the birds were seen about the northeast part of the island.

We have four adult specimens of this bird from Culpepper Island, two from Wenman, one from Tower, and one immature female from Barrington.

The young of *Sula variegata* somewhat resemble in general coloration the adults of *Sula brewsteri* and it may be that the birds reported by Kinberg and by Baur and Adams as the latter species were simply the immature of *S. variegata*. For some reason the young of this species is very rarely seen about the islands. We have one specimen taken at Barrington Island in May — the only immature individual of *S. variegata* that we saw. There is no authentic record of the occurrence of *S. brewsteri* at the Galapagos Archipelago, although it is a common bird at Cocos Island, which lies about four degrees north and to the east of the Galapagos.

16. SULA PISCATRIX WEBSTERI (Rothschild).

Sula piscator RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 598, 1896 (Galapagos).
Sula websteri ROTHSCHILD, Bull. Brit. Ornith. Club, VII, p. 52, May, 1898 (Clarion Island, Galapagos Islands).
Sula piscatrix websteri ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 177, 1899.

Range. — Revillagigedo Archipelago. Cocos Island. Galapagos Archipelago: Culpepper, Wenman, Tower and Hood.

We have four adult specimens in the white plumage, taken in December from Wenman and Culpepper, and three taken in November and August from Clarion Island of the Revillagigedo Archipelago. All of them have the tails mostly dark brownish as described by Rothschild; the females do not differ from the males in color. We have also six immature birds in the brownish plumage taken at Wenman and Culpepper in December and at Cocos Island in July, and one grayish bird taken from Culpepper in December.

The species is easily distinguished at all ages from all other species of *Sula* of the eastern Pacific by its bright red feet. In adults there is a narrow band of red on the bare skin about the base of the upper mandible and a large quadrate patch of the same color at the base of each ramus of the lower mandible; the skin about the eye is blue, with an elongate spot of pink in it below the eye; the gular membrane and the skin back of the base of the lower mandible are purplish-black.

We found this species nesting on Culpepper and Wenman in December, on Hood in May and on Tower in June; but it was seen nowhere else in the archipelago. Hence it is coincident in its range at the Galapagos with *Sula variegata*.

At Wenman Island we found it abundant in December on the small islet off the north side of the main island. Nests were numerous and were always placed in the low bushes that cover most of the island. The birds were never observed to alight anywhere else than in these bushes when they came to the island. The most common sound they uttered consisted of a short series of hoarse, guttural notes.

On Tower, also, they always nested in the bushes. Here the nests were placed four or five feet above the ground and consisted of twigs somewhat woven together into a circular form with a shallow depression above. Sometimes a few dry leaves were placed in the bottom of the cavity. The incubating bird holds the single egg between her feet. None of the nests at this time on Tower Island contained young birds.

This habit of nesting in trees or bushes distinguishes this species from all the other *Sulas* of the eastern Pacific, and the species occurs on all the tropical islands of this region except Clipperton, where vegetation is is wholly lacking.

MEASUREMENTS OF ADULT SPECIMENS OF *Sula piscatrix websteri*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Depth of Bill at Base.	Tarsus.	Middle Toe.
4282	Wenman.	♂	720	371	212	85	36	35	58
4273	"	"	750	385	247	85	31	39	63
3841	"	♀	705	395	220	85	34	34	59
3840	"	"	775	393	223	92	37	35	64
5024	Clarion.	♂	760	407	235	88	34	36	61
3842	"	♀	750	403	218	89	32	39	63
5009	"	"	765	395	240	88	34	38	65

On Culpepper, Wenman and Tower, birds in the white plumage were very scarce compared with the number of those in the immature brownish plumage. The majority of nests containing eggs or young birds we found occupied by one of these fully grown but brownish birds. These individuals were certainly immature, but must have been at least six months old. They were fed by the adults with disgorged flying fish (*Exocœtus volitans*) and young specimens of *Hemiramphus*. These immature birds appear to remain on the nest for a long time, perhaps nearly a year, being fed by the parents; and reciprocate by incubating the eggs. The young when just hatched are naked, but soon become covered with a white down.

17. SULA NEBOUXI Milne-Edwards.

Sula nebouxi Milne-Edwards, Ann. Soc. Nat. Zool., XIII, p. 37, pl. 14, 1882 (Chile).—Ridgway, Proc. U. S. Nat. Mus., XIX, p. 596, 1896 (Galapagos).—Rothschild and Hartert, Novit. Zool., VI, p. 596, 1899.

Range. — Pacific coast of tropical America and the Galapagos Islands.

This is the most common and most widely spread *Sula* of the archipelago. We observed it about all of the islands except Culpepper, although at Wenman it is rare. Its breeding habits are different from those of both *S. variegata* and *S. piscatrix websteri* in that it invariably nests on cliffs. During the winter the cliffs about Tagus Cove, Albemarle, afford a roosting place for a large number of these birds, who sit on the ledges in an almost upright position, seldom assuming the squatting goose-like attitude of the other two species. They are very quiet birds; even when a large number are together on the face of a cliff it is only occasionally that one is heard to make any sound. Their notes and their voice are very similar to those of *S. variegata*, consisting of a harsh squawk and a whistling sound. They are expert divers and often drop almost vertically head downward from great heights into the water in order to capture a passing fish. Under the water they turn and soon come to the surface. The Harris expedition reports this species as breeding on Hood and Gardner (near Charles) Islands during the latter part of October and on Abingdon Island in August. We found it nesting on Albemarle and Narboro in March and on Hood in May.

MEASUREMENTS OF ADULT SPECIMENS OF *Sula nebouxi*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Depth of Bill at Base.	Tarsus.	Middle Toe.
4220	Albemarle.	♂	835	425	247	106	37	50	70
4344	"	♀	878	442	244	108	38	55	75
4032	Narboro.	"	870	440	255	111	37	53	78

Our collection contains two adult females and one adult male taken about Albemarle and Narboro in January, February and March.

In life the bare parts of the bird are colored as follows: bill slate-blue; bare skin of sides of head and about base of bill grayish-blue; gular sac light blue; iris varying from cream color to straw-color; tarsus and toes bright pea-green to blue-green, webs blue-green to indigo; claws grayish-dusky.

Family PHALACROCORACIDÆ.

Genus **Phalacrocorax** Brisson.

Phalacrocorax BRISSON, Ornithologist, VI, p. 511, 1760.

Range. — Cosmopolitan except Polynesia. Galapagos Archipelago.

18. PHALACROCORAX HARRISI Rothschild.

Phalacrocorax harrisi ROTHSCHILD, Bull. Brit. Ornith. Club, VII, p. 52, 1898. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 179, 1899 (Galapagos).
Nannopterum harrisi SHARPE, Gen. and Spec. Birds, p. 235, 1899.

Range. — Galapagos Archipelago: Narboro and Albemarle.

This species was first obtained by the Harris expedition. It is surprising that so striking a bird should never have been reported before.

Our collection contains seven specimens from Narboro and Albemarle. They all agree with Rothschild's description of the *type*, but show in addition a greenish iridescence on the upper parts. The color below varies considerably. Some of the darkest males from Narboro are seal brown below. A nesting female from Albemarle is light tawny on the breast, a little darker on the abdomen. The gular sac in life is livid-purplish, or brownish-purple; the iris emerald; the upper mandible black with pale brown tip and tomia; the lower mandible light brown with darker tomia; the feet and webs black, claws slaty black. The pupil is elliptical with the longer diameter horizontal.

Occurs abundantly in the surf and on the shore and rocks of Narboro. A few also were found along the shores of Banks Bay and at Black Bight, Albemarle. The birds are entirely unable to fly. When on shore they sit in an upright position and often extend the wings with their planes vertical, somewhat in the manner of vultures while digesting their food. In the water they have a very graceful appearance, carrying the neck bent in a very swanlike fashion. The adults were never heard to make any sound.

The food consists largely of devilfish (*Octopus*), which the birds obtain by diving. Some were observed swallowing devilfish more than a foot in length. Fish also form a part of their food. The young are fed by the parents with disgorged food until they have attained nearly adult size. A large, immature bird may often be seen pursuing an adult through the surf with loud cries and savage thrusts of the beak, until the latter comes to terms, thrusts its beak into the open mouth of the young and disgorges into it a mass of partially digested food.

In January, at Black Bight, Albemarle, a small rookery was found, consisting of four occupied nests. The nests were placed on a flat, smooth sheet of lava at the edge of a small lagoon. They were made of brown algæ heaped up into cone-shaped masses about a foot high, hollowed out at the top to receive the eggs. A nest measured had the following dimensions: External diameter, seventy-five centimeters; internal diameter, forty centimeters; depth of the cavity, ten centimeters. The birds here were all in pairs, the females sitting on the nests, the males standing quietly nearby. The females stubbornly defended their nests when disturbed, making savage thrusts with their bills and hissing loudly. Two of the nests contained each three well incubated eggs. One of the others contained two eggs and one young, the other one egg and two young. The nestlings were black and naked. The eggs are elongate-oval or narrowly elliptical in shape and have a light bluish-green color. This color is usually, however, hidden by a white chalky deposit. The eggs of the two sets measure as follows: 71×42.5, 67×42.5, 67×43, and 68×41, 68×45, 59×41.

MEASUREMENTS OF ADULT SPECIMENS OF *Phalacrocorax harrisi.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Tarsus.	Middle Toe.
4086	Narboro.	♂	930	186	145	67	86	82
3912	"	"	880	188	145	75	83	81
3895	"	"	900	185	155	63	81	80
3937	"	"	910	184	165	62	73	77
3976	"	"		190	165	60	75	76
4245	Albemarle.	♀	870	180	165	65	75	75
3891	"	"	900	175	165	62	78	77

Family PELECANIDÆ.

Genus **Pelecanus** Linnæus.

Pelecanus LINNÆUS, Syst. Nat., ed. x, 1, p. 132, 1758.

Range.—Cosmopolitan, except Polynesia. Galapagos Archipelago.

19. PELECANUS CALIFORNICUS Ridgway.

Pelecanus fuscus SUNDEVALL, Proc. Zool. Soc., p. 125, 1871 (Galapagos).
Pelecanus fuscus (?) *californicus* RIDGWAY, Water Birds N. A., II, p. 143, 1884; Proc. U. S. Nat. Mus., XIX, p. 593, 1896 (Galapagos).
Pelecanus fuscus californicus ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 176, 1899 (Galapagos).

Range. — Pacific Coast of America from Washington to Peru. Galapagos Archipelago: Charles, Hood, Chatham, Barrington, Seymour, Indefatigable, James, Albemarle, Narboro, Abingdon, Bindloe and Tower.

Generally most abundant on the leeward side of islands, specially numerous about Tagus Cove, Albemarle, and on the east shore of Narboro, seeming to prefer places affording a considerable expanse of smooth water. Old rookeries were found on Narboro, the nests being situated in small bushes near the coast. Rothschild reports a nest of three eggs taken among the mangroves of Indefatigable in September by the Harris expedition.

MEASUREMETS OF ADULT SPECIMENS OF *Pelecanus californicus.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Tarsus.	Middle Toe.
4217	Albemarle.	♀	1290	538	150	76	307	100
3834	"	"	1300	535	145	73	305	105
4262	"	"	1290	540	136	71	305	104
3981	Narboro.	"		530	136	72	312	104

We have four adult females, all in the postnuptial plumage, and they are indistinguishable from the California specimens. The gular pouch of a female taken at Elizabeth Bay, Albemarle, in February, was colored in life as follows: Ground color very pale brown; numerous much darker lines of purplish-brown arising at the sides of the base of the pouch and running forward parallel with the ramus of the mandible on each side, meeting in the median line in pairs forming acute angles; posteriorly along the edges of the pouch the lines indistinct and the purplish color rather diffuse; veins with a greenish-blue color; bill, upper mandible horn-greenish, basally with indistinct yellowish streaks, toward the tip this color median only, sides of mandible becoming scarlet, claw lemon-yellow, with dusky shade at base; lower mandible greenish and yellowish at base, in front of this mottled with yellowish, greenish and scarlet, still farther forward entirely scarlet, tip same as claw of upper mandible. Bare skin at base of bill dark purplish. Lower eyelid pink. In another specimen of the same date the ground color of the pouch was pale yellowish-green, the lines dark brown, almost no purplish color, a shade of the latter color along the rami of the mandible and edges of the throat feathers; bill colored the same as first specimen, but the lower eyelid purplish.

Family FREGATIDÆ.

Genus **Fregata** Brisson.

Fregata BRISSON, Ornithologist, VI, p. 506, 1760.

Range.—Intertropical seas.

20. FREGATA AQUILA (Linnæus).

Pelecanus aquilus LINNÆUS, Syst. Nat., ed. X, I, p. 133, 1758.
Fregata aquila RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 590, 1896 (Galapagos).—ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 175, 1899.
Fregata aquila minor RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 591, 1896 (Galapagos).

Range. — Intertropical and subtropical seas. Galapagos Islands. Common everywhere about the archipelago, observed at all the islands. Found nesting on Culpepper and Wenman in December, and on Tower in June.

Family ANATIDÆ.

Genus **Anas** Linnæus.

Anas LINNÆUS, Syst. Nat., ed. X, I, p. 122, 1758.

Range. — Cosmopolitan.

21. ANAS VERSICOLOR Vieillot.

Anas versicolor VIEILLOT, Nouv. Dict. d'Hist. Nat., V, p. 109, 1816.
Querquedula versicolor SALVIN, Trans. Zool. Soc. Lond., IX, p. 499, 1876 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 614, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 183 ,1899.

Range. — Southern part of South America and the Galapagos Archipelago.

One specimen said to have been taken by Kinberg. None reported from the Galapagos since.

Genus **Pœcilonetta** Eyton.

Pœcilonetta EYTON, Monogr. Anatidæ, p. 16, 1838.

Range. — South America, West Indies, Bahamas, Galapagos.

22. PŒCILONETTA BAHAMENSIS GALAPAGENSIS (Ridgway).

Pœcilonetta bahamensis GOULD, Zool. Voy. Beagle, III, Birds, p. 135, 1841 (Galapagos).
Pœcilonetta galapagensis RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 115, 1890 (Galapagos); Proc. U. S. Nat. Mus., XIX, p. 612, 1896.
Pœcilonetta bahamensis galapagoensis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 183, 1899.

Range. — Galapagos Archipelago.

We simply follow Rothschild and Hartert in giving this form as a subspecies of *P. bahamensis*, having no material of the latter species with which to make comparisons.

This is a common species throughout the archipelago wherever suitable places occur. It is especially abundant on Albemarle, James, Charles and Chatham.

Family PHŒNICOPTERIDÆ.

Genus **Phœnicopterus** Linnæus.

Phœnicopterus LINNÆUS, Syst. Nat., ed. x, I, p. 139, 1758.

Range. — Tropical and subtropical regions. Galapagos Archipelago.

23. PHŒNICOPTERUS RUBER Linnæus.

Phœnicopterus ruber LINNÆUS, Syst. Nat., ed. x, I, p. 139, 1758. — SALVIN, Trans. Zool. Soc. Lond., IX, p. 498, 1876 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 608, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 182, 1899.
Phœnicopterus glyphorhynchus GRAY, Ibis, p. 442, pl. 14, fig. 5, 1869 (Galapagos).

Range. — Atlantic coast of Mexico and Central America, southern Florida, Galapagos Archipelago: Charles, James, Indefatigable and Albemarle.

We obtained this species on the shore of the southern half of Albemarle, a short distance west of Elizabeth Bay. Only seven individuals were seen. They were wading about quietly in the small reedy marshes back of the mangrove swamps along the shore. They were very tame and reluctantly swam to the opposite side of the small ponds when approached. Only one was seen to fly and it alighted again a few yards from where it started. Another was made to run along on the surface of the water flapping its wings. The only sound they uttered was a hoarse guttural note somewhat between a squawk and a grunt, resembling a little the note of the great blue heron. Mr. G. M. Green of San Francisco reports having found the flamingoes breeding in the salt marshes about James Bay on James Island, and he obtained eggs in August.

Family ARDEIDÆ.

Genus Ardea Linnæus.

Ardea LINNÆUS, Syst. Nat., ed. x, I, p. 141, 1758.

Range. — Cosmopolitan except New Zealand and Polynesia. Galapagos Archipelago.

24. ARDEA HERODIAS Linnæus.

Ardea herodias LINNÆUS, Syst. Nat., ed. x, I, p. 143, 1758. — DARWIN, Zool. Voy. Beagle, III, Birds, p. 128, 1841 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 601, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 180, 1899.

Range. — Northern temperate and tropical America. Galapagos Archipelago: Seymour, Indefatigable, Duncan, Albemarle and Narboro.

We found this heron especially abundant in the mangrove swamps of the east shore of Narboro. In January we obtained here a set of three eggs. The nest consisted of a flat platform of large twigs, placed in a mangrove tree about a foot and a half above high water.

Genus Herodias Boie.

Herodias BOIE, Isis, p. 559, 1822.

Range. — Cosmopolitan.

25. HERODIAS EGRETTA (Gmelin).

Ardea egretta GMELIN, Syst. Nat., I, p. 629, 1788.
? Herodias egretta RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 601, 1896 (? Galapagos).
Herodias egretta ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 181, 1899 (Albemarle Island, Galapagos).

Range. — Temperate and tropical America. Galapagos Archipelago: Albemarle.

Only one specimen of the American egret has been obtained at the Galapagos; it was taken by the Harris expedition and determined by Rothschild and Hartert to be the same as South American birds. Baur and Adams reported finding on Albemarle "a rookery of white herons." We saw one individual on a small island in the center of a lake in the bottom of the large tufa crater just south of Tagus Cove, Albemarle.

Genus **Butorides** Blyth.

Butorides BLYTH, Cat. Birds, Mus. Asiat. Soc., p. 201, 1849.

Range. — North and South America, Africa, southern Asia to Australia.

26. BUTORIDES PLUMBEUS (Sundevall).

Butorides javanicus SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, 1870 (Galapagos).

Ardea plumbea SUNDEVALL, Proc. Zool. Soc. Lond., pp. 125–127, 1871 (Galapagos).

Butorides plumbeus RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 602, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 181, 1899.

Range. — Galapagos Archipelago: Chatham, Hood, Charles, Barrington, Indefatigable, Seymour, Duncan, Jervis, James, Albemarle, Narboro, Bindloe, Abingdon, Tower and Wenman.

Common almost everywhere in the archipelago, especially so in the mangrove swamps of Albemarle and Narboro. They are very tame and allow one to approach them closely before they fly. When they take flight, whether frightened or not, they nearly always utter in slow succession elongated squawks. When about to alight they shorten the notes and utter them more rapidly. In February we secured a set of three eggs at Elizabeth Bay, Albemarle. The nest consisted of a loosely constructed platform of dead twigs, placed in a tree of a mangrove swamp, about eight feet above the water. The eggs are plain light green, measuring 41 × 33, 41 × 32.5, and 42 × 33. They are widest at the middle and symmetrically narrowed at each end.

Genus **Nyctanassa** Stejneger.

Nyctanassa STEJNEGER, Proc. U. S. Nat. Mus., X, p. 295, 1887.

Range. — Temperature North America and all of Middle and South America. Galapagos Archipelago.

27. NYCTANASSA VIOLACEA (Linnæus).

Ardea violacea LINNÆUS, Syst. Nat., ed. X, I, p. 143, 1758.

Nycticorax violaceus GOULD, Zool. Voy. Beagle, III, Birds, p. 128, 1841 (Galapagos).

Nyctanassa violacea RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 606, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 182, 1899.

Range. — Tropical and southern north temperature parts of America. Galapagos Archipelago: Charles, Hood, Chatham, Indefatigable, Seymour, James, Albemarle, Narboro, Bindloe and Tower.

This heron is not nearly so common about the archipelago as the last. We obtained one set of three eggs in May on Indefatigable. The nest was on the ground in the brush about four hundred yards back from the shore at the northeast corner of the island near Seymour Island. The eggs are identical in color with those of the last species, *Butorides plumbeus*, but they are larger and the longest transverse diameter is a little nearer one end than the other, giving them a slightly ovate shape. They measure 48 × 37, 45.5 × 36, and 49 × 36.

Family RALLIDÆ.

Genus Porzana Vieillot.

Porzana VIEILLOT, Analyse, p. 61, 1816.

Range. — Cosmopolitan. Galapagos Archipelago.

28. PORZANA SPILONOTA (Gould).

Zapornia spilonota GOULD, Zool. Voy. Beagle, III, Birds, p. 132, pl. 49, 1841 (Galapagos).

Porzana spilonota SALVIN, Trans. Zool. Soc. Lond., IX, p. 500, 1876 (James and Indefatigable Islands).—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 618, 1896.

Porzana galapagoensis SHARPE, Cat. Birds Brit. Mus., XXIII, p. 113, 1894 (Galapagos).—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 619, 1896.

Creciscus spilonotus ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 184, 1899.

Range. — Galapagos Archipelago: James Island.

This species is known only from the original specimens taken by Darwin on James. We take the above synonymy from Rothschild and Hartert, who have examined the *types*.

29. PORZANA SHARPEI (Rothschild and Hartert).

Creciscus sharpei ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 185, 1899, (Indefatigable Island).

Porzana spilonota SCLATER AND SALVIN (not of Gould), Proc. Zool. Soc. Lond., p. 456, 1868; p. 323, 1870 (Indefatigable Island).—SALVIN, Trans. Zool. Soc. Lond., p. 500, 1876 (James and Indefatigable Islands) (in part).—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 618, 1896 (in part).

Creciscus spilonotus SHARPE (not of Gould), Cat. Birds Brit. Mus., XXIII, p. 137, 1894 (Indefatigable Island).

Range. — Galapagos Archipelago: Indefatigable and Narboro.

MEASUREMENTS OF ADULT SPECIMENS OF *Porzana sharpei.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Depth of Bill at Base.	Width of Bill at Base.	Tarsus.	Middle Toe.
4017	Narboro.	♂	153	64	24.0	15.0	6.0	4.0	21	24
3994	"	♀	150	65	25.5	14.5	5.5	4.5	23	25

We have two specimens of a *Porzana*, an adult male and an adult female, taken in January in a mangrove swamp on the east shore of Narboro, which differ in no way from the description of *P. sharpei* by Rothschild and Hartert. These two specimens are the only rails that we saw, although much time was spent looking for others.

Genus **Galinula** Brisson.

Galinula BRISSON, Ornithologist, VI, p. 2, 1760.

Range. — Cosmopolitan. Galapagos Archipelago.

30. GALINULA GALEATA (Lichtenstein).

Crex galeata LICHTENSTEIN, Verz. Doubl., p. 80, 1823.
Galinula galeata RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 621, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 186, 1899.

Range. — Tropical and most of temperate America. Galapagos Archipelago: Albemarle.

We obtained two specimens of this species in February near Elizabeth Bay, Albemarle. The galinules were rather plentiful in the small reedy marshes and salt pools back of the mangrove swamps bordering the north shore of southern Albemarle west of Elizabeth Bay.

MEASUREMENTS OF ADULT SPECIMENS OF *Galinula galeata*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen from Top of Frontal Shield.	Width of Frontal Shield.	Depth of Bill at Base.	Width of Bill at Base.	Tarsus.	Middle Toe.
4233	Albemarle.	♂	370	183	60	45	13	13	10	54	63
4239	"	"	360	170	74	48	14	11	9	58	69

Family **PHALAROPODIDÆ.**

Genus **Phalaropus** Brisson.

Phalaropus BRISSON, Ornithologist, VI, p. 12, 1760.

Range. — Breeding in arctic and subarctic regions of both hemispheres, migrating into the tropics.

31. PHALAROPUS LOBATUS (Linnæus).

Tringa lobata LINNÆUS, Syst. Nat., ed. x, I, pp. 148, 824, 1758.

Range. — Northern parts of northern hemisphere; south in winter to the tropics. Galapagos Archipelago.

We obtained two specimens of this species March 29 from a flock on the water off the southeast point of Narboro. It has not hitherto been reported from the Galapagos. We saw the birds several times in that vicinity.

Family RECURVIROSTRIDÆ.

Genus **Himantopus** Brisson.

Himantopus BRISSON, Ornithologist, VI, p. 33, 1760.

Range. — Cosmopolitan (littoral). Galapagos Archipelago.

32. HIMANTOPUS MEXICANUS (Müller).

Charadrius mexicanus MÜLLER, Syst. Nat. Suppl., p. 117, 1776.
Himantopus mexicanus RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 633, 1896 (Galapagos). — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 189, 1899.

Range. — South temperate and tropical America. Galapagos Archipelago.

This bird is rather rare about the archipelago. They seem to prefer lakes and ponds of quiet water rather than the ocean beaches and rocks along the shore. We observed them about the lake in the crater a short distance south of Tagus Cove, Albemarle, on the ponds back of the beach at James Bay, James Island, about similar ponds on the west side of the southern Seymour Island, and at a lake on the upper part of Hood.

Family SCOLOPACIDÆ.

Genus **Tringa** Linnæus.

Tringa LINNÆUS, Syst. Nat., ed. X, I, p. 148, 1758.

Range. — Arctic and subarctic during the breeding season, cosmopolitan during migrations. Galapagos Archipelago.

33. TRINGA BAIRDII (Coues).

Actodromas bairdii COUES, Proc. Acad. Nat. Sci. Phila., p. 194, 1861.
Heteropygia bairdi ROTHSCHILD AND HARTERT, Novit. Zool., XIX, p. 188, 1899 (Galapagos).

Range. — Breeding in Alaska, migrating south to the interior of North America and west coast of South America. Galapagos Archipelago.

Rothschild and Hartert report the only specimen of this species known from the Galapagos Archipelago, as taken by the Harris expedition on Barrington in October.

34. TRINGA MINUTILLA Vieillot.

Tringa minutilla VIEILLOT, Nouv. Dict., XXXIV, p. 452, 1819. — SCLATER AND SALVIN, Proc. Zool. Soc. London, p. 323, 1870 (Galapagos). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 631, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 188, 1899.

Range. — Northern North America, migrating over the entire American continent. Galapagos Islands.

This sandpiper is but infrequently met with on the Galapagos Islands.

Genus **Calidris** Cuvier.

Calidris Cuvier, Leç. Anat. Comp., i, pl. 2, 1800.

Range. — Cosmopolitan during migrations, breeding only in northern regions. Galapagos Archipelago.

35. CALIDRIS ARENARIA (Linnæus).

Tringa arenaria Linnæus, Syst. Nat., ed. xii, i, p. 251, 1766.
Calidris arenaria Ridgway, Proc. U. S. Nat. Mus., xix, p. 629, 1896 (Galapagos).—Rothschild and Hartert, Novit. Zool., vi, p. 187, 1899.

Range. — Cosmopolitan during migration. Galapagos Archipelago.

Found occasionally at the Galapagos, generally in winter. The Harris expedition took one specimen, however, as early as July 29.

Genus **Helodromas** Kaup.

Helodromas Kaup, Skizz. Entw.-Gesch. Eur. Thierw., p. 144, 1829.

Range. — Cosmopolitan during migration, breeding in the northern parts of the northern hemisphere. Galapagos Archipelago.

36. HELODROMAS SOLITARIUS (Wilson).

Tringa solitaria Wilson, Amer. Orn., vii, p. 53, pl. 58, fig. 3, 1813.
Helodromas solitarius Rothschild and Hartert, Novit. Zool., vi, p. 188, 1899 (Galapagos).

Range. — Breeding in northern North America, in winter migrating south to southern South America. Galapagos Archipelago.

A chance visitor at the Galapagos during winter migrations. Rothschild and Hartert report two specimens taken October 12 on Chatham by the Harris expedition.

Genus **Heteractitis** Stejneger.

Heteractitis Stejneger, Auk, i, p. 236, 1884.

Range. — Shores and islands of the Pacific Ocean. Galapagos Archipelago.

37. HETERACTITIS INCANUS (Gmelin).

Scolopax incanus Gmelin, Syst. Nat., i, Pt. ii, p. 658, 1788.
Heteractitis incanus Ridgway, Proc. U. S. Nat. Mus., xix, p. 632, 1896 (Galapagos). — Rothschild, Novit. Zool., vi, p. 188, 1899.

Range. — Pacific coast of America and eastern islands of Polynesia. Galapagos Archipelago.

A frequent winter visitor at the Galapagos where it has been reported from nearly all of the islands.

Genus **Actitis** Illiger.

Actitis ILLIGER, Prodr., p. 262, 1811.

Range. — Nesting in the northern part of both hemispheres, almost cosmopolitan during migration.

38. ACTITIS MACULARIA (Linnæus).

Tringa macularia LINNÆUS, Syst. Nat., ed. xii, I, p. 249, 1766.
Tringoides macularia SHARPE, Cat. Birds Brit. Mus., XXIV, p. 468, 1896.

Range. — North America, migrating in winter to northern and central South America. Galapagos Archipelago.

This bird is a chance visitor at the Galapagos in winter. We have one specimen taken at Tagus Cove, Albemarle, in January. Other collectors have not reported it.

Genus **Numenius** Brisson.

Numenius BRISSON, Ornithologist, VI, p. 311, 1760.

Range. — Breeding in northern parts of northern hemisphere; cosmopolitan during migration. Galapagos Archipelago.

39. NUMENIUS HUDSONICUS Latham.

Numenius hudsonicus LATHAM, Ind. Orn., p. 712, 1790. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 633, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 189, 1899.
Numenius borealis SALVIN, Proc. Zool. Soc. Lond., p. 429, 1883.

Range. — Arctic and subarctic regions of North America during breeding season; during migration, central and South America. Galapagos Archipelago.

Not numerous at the Galapagos, but frequently seen during winter. We saw more individuals along the eastern shore of Narboro Island than anywhere else.

The specimen in the British Museum, collected by Markham at the Galapagos Islands, and recorded by Salvin as *Numenius borealis*, is said by Rothschild and Hartert to be *N. hudsonicus*.

Family CHARADRIIDÆ.

Genus **Squatarola** Cuvier.

Squatarola CUVIER, Règ. Anim., I, p. 467, 1817.

Range. — Arctic during breeding season, cosmopolitan during migrations. Galapagos Archipelago.

40. SQUATAROLA SQUATAROLA (Linnæus).

Tringa squatarola LINNÆUS, Syst. Nat., ed. x, I, p. 149, 1758.
Squatarola squatarola RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 626, 1896 (Galapagos).—ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 187, 1899 (Galapagos).

Range.—Same as that of the genus given above.

This species occurs at the Galapagos in both winter and summer. It was taken by Baur and Adams in August, by the Harris expedition in November, and by us in February. It is not of common occurrence. We have only one specimen; taken at Elizabeth Bay, Albemarle.

Genus **Ægialitis** Boie.

Ægialitis BOIE, Isis, p. 558, 1822.

Range. — Cosmopolitan. Galapagos Archipelago.

41. ÆGIALITIS SEMIPALMATA (Bonaparte).

Charadrius semipalmatus BONAPARTE, Journ. Acad. Nat. Sci. Phila., v, p. 98, 1825.
Ægialitis semipalmata RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 628, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 186, 1899.

Range. — Breeding in arctic and subarctic parts of North America, migrating in winter south to northern South America. Galapagos Archipelago.

This bird has been taken at the Galapagos Islands during both summer and winter. Rothschild and Hartert report it taken by the Harris expedition from July 29 to December 3. We have two specimens taken in January, one at Turtle Point near Tagus Cove, Albemarle, and the other on the east shore of Narboro. The birds were very wild and hard to approach — qualities that distinguish all the visitant birds of the archipelago from the resident birds.

Family APHRIZIDÆ.

Genus **Arenaria** Brisson.

Arenaria BRISSON, Ornithologist, v, p. 132, 1760.

Range. — Northern parts of northern hemisphere during the breeding season; coasts of the entire world during migration.

42. ARENARIA INTERPRES (Linnæus).

Tringa interpres LINNÆUS, Syst. Nat., ed. x, I, p. 148, 1758.
Arenaria interpres RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 625, 1896 (Galapagos). — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 187, 1899.

Range. — Same as that of the genus given above.

Common on the shores of most of the islands, and appears to be found at the archipelago throughout the year. The birds are very wild, however, and evidently not resident there. Taken by Baur and Adams in June and July, by the Harris expedition from September to November, and by us in January and March.

Family **HÆMATOPODIDÆ.**

Genus **Hæmatopus** Linnæus.

Hæmatopus LINNÆUS, Syst. Nat., ed. x, I, p. 152, 1758.

Range. — Nearly cosmopolitan. Galapagos Archipelago.

43. HÆMATOPUS GALAPAGENSIS Ridgway.

? *Hæmatopus palliatus* SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, 1870 (Galapagos).
Hæmatopus galapagensis RIDGWAY, Auk, III, p. 331, 1886 (Chatham Island, Galapagos); Proc. U. S. Nat. Mus., XIX, p. 621, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 186, 1899.

Range. — Galapagos Archipelago: Chatham, Hood, Barrington, Indefatigable, Seymour, James, Albemarle, Narboro, Bindloe and Tower.

These birds are not specially abundant anywhere but one sees them at nearly every place on the shores of the islands. We found them specially frequent in the small pools just back of the shore on the west side of the southern Seymour Island. They were always very tame.

Family **COLUMBIDÆ.**

Genus **Nesopelia** Sundevall.

Nesopelia SUNDEVALL, Meth. Nat. Av. Disp. Tentam., p. 99, 1872.

Range. — Galapagos Archipelago.

Allied to *Zenaida* but differing from it in the possession of twelve instead of fourteen rectrices.

44. THE NESOPELIA GALAPAGOENSIS SERIES.

44*a*. NESOPELIA GALAPAGOENSIS GALAPAGOENSIS (Gould).

Zenaida galapagoensis GOULD, Zool. Voy. Beagle, III, Birds, p. 115, pl. 46, 1841 (Galapagos Archipelago).
Nesopelia galapagoensis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 614, 1896.
Nesopelia galapagoensis galapagoensis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 183, 1899.

Range. — Charles, Hood, Chatham, Barrington, Indefatigable, Duncan, Jervis, James, Albemarle, Narboro, Abingdon, Bindloe and Tower.

This is a common bird on most of the islands of the archipelago, rare only on Charles and Albemarle. This may be due to the number of dogs and cats on these two islands, since the species nests on the ground. The birds seem to be more or less migratory, for during January and March we saw only one or two doves about Tagus Cove on Albemarle, while in June they were not infrequent here and at this time we often saw small flocks at Turtle Point just north of Tagus Cove.

One nest was found in April on James Island. It consisted of a few straws and leaves lining a cavity in the surface of a rough lava bed. The nest contained one egg; the female was collected and another egg was found in the oviduct nearly ready to be laid. The first one is dull white, oval, and measures 27.5 × 22.5. On Barrington the doves were found nesting during the latter part of May. The nests were all on the ground between blocks of lava, and contained each two eggs like the one from James.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesopelia galapagoensis galapagoensis.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.	Middle Toe.
3945	Narboro.	♂	238	123	67	16.3	13.3	24	21
3882	"	"	240	127	66	16.3	13.5	23	22
4412	"	"	245	129	76	16	14	23	22
4453	"	"	250	134	71	17	14	23.5	20.5
3889	"	♀	218	120	68	15	14	21.5	19
5023	Albemarle, Iguana Cove.	"	220	119	73	16	13	20	21
5252	" Tagus "	"	215	113	67	16.5	13.5	22.5	21
4466	James.	"	220	120	68	16	12.5	23	20
5172	Duncan.	"	225	118	67	15.5	12.5	21.5	20.5
4989	Barrington.	"	211	118	67	15	12	21	20
4898	Hood.	♂	247	134	78	17.5	13.5	22	24
5306	Tower.	"	244	130	78	17.7	14.3	23.7	22

44*b*. NESOPELIA GALAPAGOENSIS EXSUL Rothschild and Hartert.

Nesopelia galapagoensis exsul ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 184, 1896 (Culpepper and Wenman Islands).

Range. — Culpepper and Wenman.

This form is considerably larger than *N. g. galapagoensis*, having a larger body, longer wings, and a longer and heavier bill. The wing in the males in our collection is not less than one hundred and thirty nine millimeters in length, and the culmen in the males is in all cases greater than eighteen millimeters. In the specimens of males from the other islands the wing does not exceed one hundred and thirty four millimeters and the culmen is in all cases less than eighteen millimeters. No differences of color are appreciable between the two subspecies. The difference between the males of the two forms is such that they might almost be given the rank of species. The females are more nearly alike, being in each case smaller than the males.

The subspecies was very common on Culpepper and Wenman. We have seven specimens taken in December.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesopelia galapagoensis exsul.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.	Middle Toe.
5312	Culpepper.	♂	260	139	79	19.5	15	26.5	23.5
5315	"	"	255	141	76	19	15	26.5	22
5316	"	"		144	82	19.5	16	26	23.7
5312	"	♀	230	125	66	16.7	14	23	21.3
5314	"	"	236	126	68	17	14	22.5	21
5317	"	"		128	72	17.5	14	23.3	21.7
3859	Wenman.	♂	248	140	79	18.5	15	24.5	22

Family FALCONIDÆ.

Genus Buteo Cuvier.

Buteo CUVIER, Leç. Anat. Comp., I, Tabl. II, Ois., 1800.

Range. — Cosmopolitan, excepting most of the Australian region. Galapagos Archipelago.

45. BUTEO GALAPAGOENSIS (Gould).

Polyborus galapagoensis GOULD, Proc. Zool. Soc. Lond., p. 9, 1837 (Galapagos Islands).

Craxirex galapagoensis GOULD, Zool. Voy. Beagle, III, Birds, p. 23, pl. 2, 1841.

Buteo galapagoensis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 587, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 174, 1899.

Range. — Hood, Chatham, Barrington, Indefatigable, Duncan, Jervis, James, Albemarle, Narboro, Abingdon and Bindloe.

Closely allied to *Buteo swainsoni* of North America, from which it differs in the larger bill and feet.

Coloration of the Naked Parts in Life. — Iris seal-brown in the adult, ochreous-buff in the young; cere and base of mandible naples yellow; upper mandible bluish-brown at the base, blackish at the tip; feet and legs maize-yellow, claws blackish.

We have two adult specimens from Albemarle in the dark phase, and one immature specimen in the tawny phase. We observed the species frequently on Narboro, but we did not collect any specimens here. It was seen also on James, Duncan, Indefatigable, Barrington, Hood, Chatham, Abingdon and Bindloe. It is fairly common throughout its range but is most numerous along the coast, showing, however, no preference for any special kind of country. It is equally abundant on barren stretches of lava and on areas of dense vegetation. It is extremely tame and will usually come within a few feet of a collector and sometimes closer still if he has any food to offer. The birds feed principally on the common lizard, *Tropidurus*, which abounds on nearly all the islands near the shore. All the specimens examined contained remains of these lizards. The rarity of this lizard on Charles, where it is now nearly extinct, may explain the absence of *Buteo* from this island. Similarly, the islands of Tower, Wenman and Culpepper, where the buzzard is lacking are also without representatives of *Tropidurus*. Darwin says that the *Buteo* feeds on the young of the land tortoise, *Testudo*, when just emerging from the shell. If this is the case, it is probable that they likewise eat the young of the green sea turtle, *Chelone*, which breeds abundantly on the sand beaches.

A nest containing two incubated eggs was found on Bindloe in June. The nest was situated on a ledge of lava projecting from the perpendicular side of a canyon; it was a very bulky affair made of sticks and twigs and lined with leaves. Both of the parents were in the dark phase of plumage, which is probably the adult color. Only one of these eggs was preserved. It is immaculate greenish-white, about the same color as the eggs of *Circus hudsonius* (Linn.), and measures 58 × 44.

Another nest was found in January near Tagus Cove, Albemarle, situated on a high pinnacle of lava near the middle of a very rough lava stream. This nest was very large. The height being about three feet and the basal width nearly as great. It had evidently been used for many years. A pair of buzzards in dark plumage remained most of the time in the neighborhood and were presumably the owners. We never got any eggs from this nest, but the breeding season evidently does not begin until June.

MEASUREMENTS OF ADULT SPECIMENS OF *Buteo galapagoensis.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Tarsus.	Middle Toe.
3946	Albemarle, Point Christopher.	♂	535	405	223	40	70	48
3965	" " "	♀	575	430	252	41	71	55

Family STRIGIDÆ.

Genus Strix Linnæus.

Strix Linnæus, Syst. Nat., ed. x, i, p. 92, 1758.

Range. — Almost cosmopolitan. Galapagos Archipelago.

46. STRIX PUNCTATISSIMA Gray.

Strix punctatissima Gray, Zool. Voy. Beagle, iii, Birds, p. 34, 1841 (James Island).—Ridgway, Proc. U. S. Nat. Mus., xix, p. 583, 1896.—Rothschild and Hartert, Novit. Zool., vi, p. 175, 1899.

Range. — James, Indefatigable, South Seymour, Abingdon and Albemarle. (Records of this species from the mainland are doubtful.)

Two immature specimens are in the collection. They are only slightly fulvous below, being chiefly grayish, spotted with dark brownish. The wing in each is less than two hundred and thirty millimeters. One of the specimens is from near Tagus Cove, Albemarle, where it was secured in a cavity on the side of a steep walled canyon; the other was taken from a cavity between some rocks on Seymour Island.

Several old nesting burrows were seen on canyon sides near Tagus Cove, Albemarle, and in one an old unhatched egg was found. This egg is whitish and in shape is slightly more spherical than the eggs of *Strix pratincola* Bonap. It measures 41 × 31. The entrances to the burrows were strewn with the skulls and other remains of rats (*Mus*), the rodents apparently forming the greater part of the food of the owls.

Family BUBONIDÆ.

Genus Asio Brisson.

Asio Brisson, Ornithologist, i, p. 28, 1760.

Range. — Absent in most of the Australian region, otherwise cosmopolitan. Galapagos Archipelago.

47. ASIO GALAPAGOENSIS (Gould).

Brachyotus galapagoensis GOULD, Proc. Zool. Soc. Lond., p. 10, 1837 (Galapagos Islands).
Otus galapagoensis GOULD, Zool. Voy. Beagle, III, Birds, p. 32, pl. 3, 1841.
Asio galapagoensis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 585, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 175, 1899.

Range. — Chatham, Hood, Barrington, Indefatigable, Duncan, James, Albemarle, Bindloe, Tower and Culpepper.

This species is a local form of the nearly cosmopolitan *Asio accipitrinus* (Pall.). It differs from the latter species in having a somewhat larger bill and conspicuously larger feet; the middle toe measuring about thirty two millimeters in length, while in *A. accipitrinus* it is about twenty seven millimeters. *A. galapagoensis* differs also in being generally darker and in having the brown streaks of the lower parts wider and persistent upon the posterior part of the abdomen, on the flanks, legs and under tail coverts.

This owl is more common on the Galapagos Archipelago than the only other species found there, *Strix punctatissima*. On some of the islands it is fairly abundant, especially on Duncan and Barrington. Throughout a part of its range this species must live entirely on birds and insects, for on Tower, Culpepper and Hood there are apparently no rodents. On Barrington and Duncan, where it is most numerous, mice and rats are abundant.

A set of four incubated eggs was taken on Barrington Island May 29. The nest consisted merely of a slight depression scraped in the scanty soil where it was found, to which no lining had been added. The eggs are white and subspherical in shape, measuring 42.5 × 34.5; 42.5 × 34; 43 × 34.5; 41 × 34.

MEASUREMENTS OF ADULT SPECIMENS OF *Asio galapagoensis*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Tarsus.	Middle Toe.
4976	Barrington.	♀	340	290	146	32	45	32
4716	Duncan.	"	375	280	155	32	43	31

Asio accipitrinus.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Tarsus.	Middle Toe.
3181	Palo Alto, California.	♀		280	150	29	46	27
3157	Pullman, Washington.	♂		305	155	27	46	26
	Monomoy Island, Massachusetts.	"		310	155	30	46	27

Family CUCULIDÆ.

Genus **Coccyzus** Vieillot.

Coccyzus VIEILLOT, Analyse, p. 28, 1816.

Range. — Temperate and tropical America. Galapagos Archipelago.

48. COCCYZUS MELANOCORYPHUS Vieillot.

Coccyzus melanocoryphus VIEILLOT, Nouv. Dict. d'Hist. Nat., VIII, p. 271, 1817. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 581, 1896 (Charles and Chatham Islands). — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 174, 1899.

Range. — Most of South America. Galapagos Archipelago: Charles, Chatham and Albemarle.

We have one adult specimen taken in May on Chatham, where the species was fairly common. On Albemarle we found it at the base of the mountain back of Tagus Cove, where in March we secured three young birds. Their notes are very similar to those of *C. americanus*. We have also one adult from Iguana Cove, Albemarle.

MEASUREMENTS OF ADULT SPECIMENS OF *Coccyzus melanocoryphus*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.	Middle Toe.
4752	Chatham.	♂	270	115	134	26	17	25.5	19.5
4328	Albemarle, Iguana Cove.	"	286	112	148	29.5	19	26	17

Family TYRANNIDÆ.

Genus **Myiarchus** Cabanis.

Myiarchus CABANIS, Arch. f. Naturg., p. 272, 1844.

Range. — All of America except arctic and antarctic regions. Galapagos Archipelago.

Subgenus **Eribates** Ridgway.

Eribates RIDGWAY, Proc. U. S. Nat. Mus., XVI, p. 606, 1893. (Type, *Myiobius magnirostris* Gray.)

Range. — Galapagos Archipelago. Represented by one species. "Tarsus as long as the bill from the rictus; lateral outlines of the bill not contracted terminally. Otherwise similar to the subgenus *Onychopterus*" (Ridgway, *Proc. U. S. Nat. Mus.*, XIX, 1896, p. 568).

49. MYIARCHUS MAGNIROSTRIS (Gray).

Myiobius magnirostris GRAY, Zool. Voy. Beagle, III, Birds, p. 48, 1841 (Chatham Island).
Myiarchus magnirostris RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 569, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 171, 1899.

Range. — Chatham, Charles, Hood, Barrington, Indefatigable, Duncan, Jervis, James, Albemarle, Narboro, Abingdon and Bindloe. (Absent on only Wenman, Culpepper and Tower.)

Our specimens are from Narboro, Albemarle, James, Abingdon, Bindloe, Hood and Chatham. No local variations have ever been discovered in this species; it is one of the few peculiar land birds which are the same on all the islands within its range.

We found the species rather common wherever it occurred, but it was probably more abundant at Iguana Cove, Albemarle, than at any other locality. The notes they generally uttered consisted of a liquid-sounding *whĭt-whĭt*, sometimes varying to *whĭt-weé*, the note so common to all small flycatchers. The nidification and eggs are unknown.

MEASUREMENTS OF ADULT SPECIMENS OF *Myiarchus magnirostris*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Width of Bill at Base.	Maxilla from Nostril.	Tarsus.
4418	Narboro.	♂	167	73	69	16.3	7	11.5	21
4414	"	♀		68	66	15	7	10.5	21
4079	Albemarle, Iguana Cove.	♂	150	72	65	16.5	6.5	12	21.5
4089	" " "	"	157	71	66	17	6	11.7	21.5
4073	" " "	♀	154	70	66	15	6.5	11.5	21
4054	" " "	"	155	66	60	15	7	11	22
4027	" " "	"	152	65	63	16	7	11	21
4070	" " "	"	157	69	65	15	6.7	10.7	22.5
3924	" Tagus "	♂	150	70	61	16	6.3	11.3	21
4251	" " "	♀	165	71	65	15	7	11	20
5276	Abingdon.	♂	163	71	67	16.5	6.3	12	21.5
4720	Bindloe.	"	158	69	65	16	7	12	22
4812	Hood.	"	164	72	67	16	7	12	21
4493	James.	"	160	73	69	16	6.7	11.5	21.5
4533	"	♀	159	69	64	15.5	7.5	11.3	21.5

Genus **Pyrocephalus** Gould.

Pyrocephalus GOULD, Zool. Voy. Beagle, III, Birds, p. 44, 1841.

Range. — Tropical and subtropical America, except the West Indies. Galapagos Islands.

50. THE PYROCEPHALUS NANUS SERIES.

50*a*. PYROCEPHALUS NANUS NANUS (Gould).

Pyrocephalus nanus GOULD, Zool. Beagle, III, Birds, p. 45, pl. 7, 1841 (Galapagos Islands).—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 572, 1896 (James Island).—ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 172, 1899.

Pyrocephalus intercedens RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 366, 1894 (Indefatigable Island), and XIX, p. 575, 1896 (Indefatigable and Albemarle Islands).

Pyrocephalus carolensis RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 365, 1894 (Charles Island).

Range. — Charles, Indefatigable, Duncan, Jervis, James, Albemarle and Narboro.

We have seven adult males from Albemarle taken at Tagus Cove, Elizabeth Bay and Iguana Cove in January, February and March, three from the east and north sides of Narboro in January and April; two from James in April; and one from Duncan in May. These males present no perceptible differences, being all dark blackish-brown on the back, dark vermilion on top of the head and bright, lighter vermilion below. The collection contains also a small number of females from these same islands and from Charles, but they vary so much in color that slight specific differences could not certainly be

MEASUREMENTS OF ADULT SPECIMENS OF *Pyrocephalus nanus nanus*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Width of Bill at Base.	Maxilla from Nostril.	Tarsus.
5045	Albemarle, Tagus Cove.	♂	137	62	51	13.5	6	9	17
5153	" " "	"	135	64			6		18.7
3940	" " "	"	137	63	51	13.7	7	10	19.5
4123	" " "	"	128	64	54	14	7	9.7	18.3
4267	" " "	♀	132	61	51	12.5	6.5	9	17
4062	" " "	"	123	61	52	12.5	6	8.5	18
3947	" " "	"	130	62	53	13		9	18.7
4223	Albemarle, Elizabeth Bay.	♂	133	66	53	14	7	9	18.5
4292	" " "	"	138	66	54	13	7	10	18
4299	" " "	"	140	65	55	13.5	6	9	18.5
4417	Narboro.	"	136	62	54	13	5.7	9	18.5
3879	"	"	128	64	52	12	5.5	9	18
3886	"	"	136	64	52	13.5	6	9.5	18
	"	♀	135	64	50	13	6.5	9.5	18
4531	James.	♂	135	64	53	13	5.5	8.5	19
4530	"	"	132	62	51	13	6	10	18.5
4553	"	♀	130	62	51	12.7	6	8.5	19
4625	Duncan.	♂	135	62	52	13.5	6	9	19

based on them. Hence we must agree with Rothschild and Hartert in placing the individuals from Charles, Indefatigable, Duncan, James, Albemarle and Narboro together in one species, including thus under *P. nanus nanus* three of Ridgway's species. The specimens from Abingdon and Bindloe may perhaps be regarded as a separate subspecies.

This species is nowhere very common, but occurs almost everywhere. The mangrove swamps of Albemarle and Narboro are a favorite haunt of this bird, but we found it pretty generally distributed from sea level to the tops of the highest mountains.

50*b*. PYROCEPHALUS NANUS ABINGDONI (Ridgway).

Pyrocephalus abingdoni RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 367, 1894 (Abingdon Island), and XIX, p. 578, 1896 (? Bindloe Island and Abingdon Island).

Pyrocephalus nanus ROTHSCHILD AND HARTERT (in part), Novit. Zool., VI, p. 172, 1899.

Range. — Abingdon and Bindloe.

This form may very doubtfully be retained as different from the last. Our specimens were all taken in June, while those of *P. nanus nanus* were taken from January to May. The Abingdon and Bindloe adult males, of which we have only three, differ from those of *P. n. nanus* in having a distinct orange shade to the vermilion of the under parts, the color being rather conspicuously different from that of the average males of *P. n. nanus*, but from some of the latter it is scarcely distinguishable. This color is called by Ridgway "flame scarlet or orange chrome," but we can scarcely recognize any such difference as this.

MEASUREMENTS OF ADULT SPECIMENS OF *Pyrocephalus nanus abingdoni*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5008	Abingdon.	♂	137	63	55				19
5071	"	"	141	65	56		5.5		18.5
5047	Bindloe.	"	138	66	54		5.7		18

51. PYROCEPHALUS DUBIUS Gould.

Pyrocephalus dubius GOULD, Voy. Beagle, III, Birds, p. 46, 1841 (Galapagos Islands). — RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 368, 1894 (Chatham Island), and XIX, p. 579, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VII, p. 173, 1899.

Pyrocephalus minimus RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 113, 1890, in text (Chatham Island).

Range. — Chatham Island.

This species differs from *P. nanus* in having a shorter wing, the wing not exceeding fifty nine millimeters in length and averaging about fifty seven millimeters, while in *P. nanus* the wing varies from sixty one to sixty six millimeters averaging about sixty three. We have four adult males: two of them are decidedly orange-red below, much more so than in *P. nanus abingdoni;* one of the others has less of an orange shade, while the fourth is indistinguishable in color from ordinary males of *P. nanus.*

We found this species fairly common on Chatham in May, where we took four adult males and two adult females. They were perhaps more plentiful in the upper cultivated parts of the island than elsewhere.

MEASUREMENTS OF ADULT SPECIMENS OF *Pyrocephalus dubius.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Width of Bill at Base.	Maxilla from Nostril.	Tarsus
4756	Chatham.	♂	132	58	49	12.5	5.5	8.3	16.5
5748	"	"	128	57	49	11	6.5	8	16.3
5743	"	"	129	58	46	11.7	5.5	8	16.5
4875	"	"	134	59	52	13	5.5	8.5	16
4834	"	♀	131	55	49	12	5	9	17
4807	"	"	129	56	48	11.5	6	8.5	17.5
5753	"	"	129	57	49	11	6	8.5	17.5

Family **ICTERIDÆ.**

Genus **Dolichonyx** Swainson.

Dolichonyx SWAINSON, Phil. Mag., I, p. 435, 1827.

Range. — Eastern North America, in winter south to South America. Galapagos Archipelago.

52. DOLICHONYX ORYZIVORUS (Linnæus).

Fringilla orizivora LINNÆUS, Syst. Nat., ed. X, p. 179, 1758.

Dolichonyx oryzivorus DARWIN, Zool. Beagle, III, Birds, p. 106, 1841 (James Island). — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 171, 1899 (Charles and Chatham Islands).

Range. — Same as that of the genus given above. On the Galapagos Archipelago: James, Charles and Chatham.

We did not meet with this species. It is recorded simply as a winter visitor, but five hundred and fifty miles of ocean is a long distance for it to traverse accidentally.

Family FRINGILLIDÆ.

Genus Geospiza Gould.

Geospiza GOULD, Proc. Zool. Soc. Lond., p. 5, 1837.
Cactornis GOULD, ibid., p. 6.
Camarhynchus GOULD, ibid., p. 6.
Platyspiza RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 545, 1896.
Cactospiza RIDGWAY, ibid., p. 546.

Range. — Peculiar to the Galapagos Archipelago and found on all of the islands.

We follow Rothschild and Hartert in combining all the Fringillid species of the Galapagos into one genus, *Geospiza*. It appears certain that they have all been derived from one form, and it is a matter of convenience more than anything else to give them all one name. Authors have heretofore disregarded the color in relating the species to one another, and have established different groups on the shape of the bill alone. The lines thus drawn have been found to break down, but, as we shall show, four well separated groups can be recognized on a color basis. These groups are nearly coincident with those that have been established on the different shapes of the bill, and the *types* of the latter each fall into one of the groups as based on the color, so that the same names may be retained. These groups are: *Cactospiza*, *Camarhynchus*, *Geospiza* and *Cactornis*. We include them under the genus *Geospiza* as subgenera, but this is making simply an arbitrary difference of degree between genera and subgenera.

The members of the genus as a whole present, in the young and adults, six different phases of plumage. Since these phases occur at definite periods in the growth of the individual birds they may be described as *stages*. The following are brief descriptions of these stages, which, throughout the discussion of *Geospiza*, we represent by the Roman numerals I to VI. Stage I is described in detail under *G. pallida*, and Stages II–VI under *G. fuliginosa parvula*.

Stage I. — General color yellowish-olive, darker above, pale below; wings dusky, the feathers widely edged with olive; middle and greater wing coverts with yellowish rufous edgings. Bill yellowish, darker above.

This stage is characteristic of the young in the first plumage of the subgenera *Cactospiza* and *Camarhynchus*.

Stage II. — Plumage brownish, paler below, feathers with darker centers showing specially as spots on the breast. Two wide, conspicuous rufous wing bands formed on the tips of the middle and greater wing coverts. Bill either entirely yellowish or yellowish below and brownish or dusky above. Plumage soft and lax.

Characteristic of the young in the second plumage of *Cactospiza* and *Camarhynchus*, and of the young in the first plumage of *Geospiza*.

Stage III. — Resembles Stage II in color, but differs in lacking the rufous wing bands, the tips of the wing coverts are gray or brownish-gray. Plumage compact, not soft and lax. Bill as in Stage II or entirely dusky.

Characteristic of the adult male and female of *Cactospiza*, of the adult female and the young in the third plumage of *Camarhynchus*, and of the adult female and young in the second plumage of *Geospiza*.

Stage IV. — Dark brown above, spotted with blackish-brown below, edges of feathers of breast and abdomen whitish. Bill mostly brownish or black.

Characteristic of immature males in the fourth plumage of *Camarhynchus* and the third of *Geospiza*, and of adult females and young in the first plumage of the lower numbers of *Cactornis*.

Stage V. — Back, head, throat and breast continuously black; wings sooty-brown; abdomen whitish. Bill black.

Characteristic of adult males of *Camarhynchus*, of immature males in the fourth plumage of *Geospiza*, and of adult females and young of the higher members of *Cactornis*.

Stage VI. — Entirely brownish-black or black, except the edges of the under tail coverts which are whitish, buffy or chestnut. Bill black.

Characteristic of adult males of *Geospiza* and *Cactornis*.

From the above description it may be seen that the four subgenera mentioned differ from one another in a very significant manner. The differences may be tabulated as follows:

A. Adult females in Stage III.
   1. Adult males in Stage III.......................... *Cactospiza*.
   2. Adult males in Stage V .... *Camarhynchus*.
   3. Adult males in Stage VI.......................... *Geospiza*.

B. Adult females in Stages IV or V...................... *Cactornis*.

It will be seen from the above that there is in the genus a regular progression toward complete melanism, *i. e.*, toward a form in which both sexes and all ages of the young would be entirely black. Hence, it appears to us that the color may be taken as the most important factor in the evolution of the genus. Almost the only other variable character is the beak. Hence, by plotting with the color variation as the ordinate and the bill variation as the abscissa, we can arrive at an approximate scheme of the relationships of the different subgenera, species and subspecies of the genus. The diagram on page 276 is formed in this way. This diagram is made out from the characters of the males only, except in the upper or *Cactornis* half of Stage VI, for in all the others the females remain in Stage III.

The diagram shows that the young of *Cactospiza* during their growth pass through Stages I and II while the adults never get beyond Stage III. The young males of *Camarhynchus* traverse Stages I, II, III and IV, arriving by maturity at Stage V. This is their ultimate condition. The males and females of *Geospiza* begin at Stage II and the male goes through all the stages up to Stage VI, which represents the maximum of blackness attained by any of the *Geospizæ*. The males of *Cactornis* are the same when adult as the males of *Geospiza*, but both males and females in their growth begin at Stage IV (or go very rapidly through Stages II and III). The female in this group reaches Stage V, or a condition similar to it. Hence, the average amount of blackness in the subgenus *Cactornis*, considering all the forms, is greater than in *Geospiza*, and for this reason we place it higher in the diagram. This scheme brings *G. conirostris conirostris* at the top of the entire *Geospiza* series. The position of the species in the diagram to the right or to the left of the main vertical line, indicates the relative slenderness or thickness respectively of the bills.

The position of the species as given in the diagram certainly represents their degrees of resemblance, but *we do not claim that it certainly represents their natural relationships.* We have no way of determining to what extent *convergent evolution* has operated in causing forms to resemble one another. However, in the discussion of the species and subspecies we have followed the order indicated in the diagram, working in each direction away from the main vertical line.

Subgenus **Cactospiza** Ridgway.

Cactospiza Ridgway, Proc. U. S. Nat. Mus., xix, p. 546, 1896 (Type, *Cactornis pallida* Sclater and Salvin).

No black on the plumage at any stage. Sexes similar, and the young resemble the adults. Color, above brown with dusky centers

Diagram of Relationships of Species and Subspecies of Geospiza.

Vertical distances represent differences in color; horizontal distances represent variations in size of the bill.

Adult Males of *Geospiza* and *Cactornis*.		Adult Males of *Camarhynchus*, Young Males of *Geospiza* in Fourth Plumage, Young Males of *Cactornis* in Second Plumage, Adult Females of *Cactornis*.	Young Males of *Camarhynchus*, in Fourth Plumage, Young Males of *Geospiza* in Third Plumage, Young of *Cactornis* in First Plumage.	Adults of *Cactospiza*, Young Males in Third Plumage of *Camarhynchus*, Adult Females of *Geospiza* and *Camarhynchus*, Young Males of *Geospiza* in Second Plumage.	Young of *Cactospiza* and *Camarhynchus* in Second Plumage, and of *Geospiza* in First Plumage.	Young of *Cactospiza* and *Camarhynchus* in First Plumage.	
Cactornis.	*Geospiza.*	*Camarhynchus.*		*Platyspiza.*			
scandens							
fatigata	*septentrionalis*						
	debilirostris			*heliobates*			
abingdoni	*difficilis*			*pallida*			
	acutirostris						
rothschildi	*minor*						Bills slender.
	fuliginosa						
	parvula						
	fortis	*prosthemelas*					
propinqua	*fratercula*	*salvini*					
	platyrhyncha	*paupera*					
	dubia	*habeli*					Bills thick.
	simillima	*incerta*					
conirostris	*bauri*	*affinis*					
	darwini	*psittacula*					
	strenua	*townsendi*					
	magnirostris	*crassirostris*					
♀ blackish.	♀ brown.	Stage V (♂ foreparts blackish).	Stage IV (black-spotted).	Stage III (brown-spotted).	Stage II (rufous wing bands).	Stage I (olivaceous).	
Stage VI (♂ entirely black).							

to the feathers, below buffy-white spotted with brown on the breast and on the sides. Bill slender; culmen curved, not greater than eighteen millimeters, contained one and one third times in the tarsus; depth of bill about equal to gonys.

The two species at present known under this subgenus without doubt stand nearer to the ancestral *Geospiza* than does any other known member of the genus. The plumage of the male and the female is the same and is identical with that of young birds of *Camarhynchus* and *Geospiza* proper before they have begun to assume the melanistic phase characteristic of all the higher *Geospizæ*. Young birds of this subgenus, in the first plumage, have a bright olivaceous color, a character common to young birds of *Cactospiza* and *Camarhynchus* but lost by all the members of *Geospiza* proper and of *Cactornis*. The adults reach the brown-spotted stage attained by the young of the other higher groups in Stage III. Hence, during their life history, the members of *Cactospiza* go through Stages I, II and III.

One member of the subgenus, *G. heliobates*, is an inhabitant exclusively of the mangrove swamps of the archipelago. It might be fancifully supposed that these mangrove swamps were the first vegetation on the islands and that *G. heliobates*, or an ancestor of the present *Geospizæ* resembling it, lived in these swamps until the islands became elsewhere fit for habitation; that then some of the birds left the swamps and became differentiated into the species of *Camarhynchus*, *Geospiza* proper, and *Cactornis;* while the others, remaining in the swamps, retained their primitive plumage, and survive at present as *G. heliobates.* The mangrove swamps were, most probably, the first vegetation of the islands on which they occur, but they are not present to any extent anywhere except on the southeast part of Albemarle, along the shores of the straits between Albemarle and Narboro, and at Elizabeth Bay, Albemarle. These islands do not by any means appear to be the oldest of the archipelago and their mangrove swamps stand on very recent lava. Hence the greater probability is that *G. heliobates* has been derived from *G. pallida*, the member of *Cactospiza* that inhabits the same areas as the other *Geospizæ*. The two species differ only in the size of the bill.

53. GEOSPIZA PALLIDA (Sclater and Salvin).

Cactornis pallida Sclater and Salvin, Proc. Zool. Soc. Lond., p. 323, 1870 (Indefatigable Island).
Cactornis hypoleuca Ridgway, Proc. U. S. Nat. Mus., xii, p. 109, 1890 (James Island).
Camarhynchus pallidus Ridgway, Proc. U. S. Nat. Mus., xix, p. 565, 1896; Bull. U. S. Nat. Mus., 50, Pt. i, p. 487, 1901.

Camarhynchus productus RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 364, 1894 (Albemarle Island); Proc. U. S. Nat. Mus., XIX, p. 566, 1896.
Geospiza pallida ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 165, 1899 (Indefatigable, Jervis, Duncan, James and Albemarle Islands).

Range. — Indefatigable, Jervis, Duncan, James and Albemarle.

Adult Male. — Cat. No. 4591, Leland Stanford Junior University Museum; James Island, April 22, 1899. Above, plain light brown, darker on the head where the feathers have distinctly dark brown centers; lighter, almost grayish-brown on the rump and upper tail coverts. Upper surface of wings and tail darker than the back, somewhat sooty-brown. The wing quills with narrow grayish outer edgings, and wider slaty inner borders. The upper wing coverts with indistinct grayish-brown edgings. Under wing coverts whitish. Lores, superciliary line, subocular and auricular regions, and entire under parts dirty buff gray, palest on the belly and under tail coverts. Under parts most strongly tinged with brownish-buff on the breast and along the sides. Throat and breast spotted with dusky. Bill black. Feet dark brown. Length 148 millimeters, wing 75, tail 48, culmen 17.5, gonys 9.3, width of bill at base 7.3, depth of bill at base 9.5, tarsus 24.

Immature. — Cat. No. 5225 Leland Stanford Junior University Museum; Iguana Cove, Albemarle, June 9, 1899. Back almost entirely pure yellowish-olive, the feathers of the head having slightly dusky central areas. The lower parts are bright yellowish-buff, considerably paler than the back. Wings and tail dusky with wide olive-buff edgings to the feathers. The feathers of the breast and sides without subterminal brown spots. Bill brownish-yellow above, pale yellowish below. Feet dark brown (specimen moulting). This plumage is what we have termed Stage I in the evolution of the color of the *Geospizæ*.

The color of the specimen just described is identical with that of young birds of the subgenus *Camarhynchus*. It was taken at about one thousand feet elevation at the south end of Albemarle, near Iguana Cove.

This species probably represents the ancestral *Geospiza* more nearly than any other species of *Geospiza* now living. In plumage it is certainly primitive, for in the adult it reaches only the stage attained by the immature birds of all the other species. Whether the bill has the shape of the ancestral *Geospiza* or not is impossible to say, since the variation of this member in the genus is so great that we can place no reliance on the supposition that it has remained constant.

Geospiza pallida differs but little from the next species, *G. heliobates* of the mangrove swamps of Albemarle and Narboro. The songs of the two species are, however, very different. That of *G. pallida*, as we heard it on James, may be represented thus: *chĭr-kēē ē-ē-ē chĭr-kēē ē-ē-ē*. It is a rare bird, the two specimens above described are the only ones we obtained.

54. GEOSPIZA HELIOBATES Snodgrass and Heller.

Geospiza heliobates Snodgrass and Heller, The Condor, p. 96, Aug., 1901 (Albemarle Island).

Range. — Albemarle and Narboro in mangrove swamps.

Specific Characters. — Very similar to *G. pallida*, resembling it in coloration, but having a smaller bill — the culmen being 15.5 millimeters or less in length, while in *G. pallida* it is 17 millimeters or more in length.

Adult Male. — Cat. No. 4186 (*type* of the species), Leland Stanford Junior University Museum; mangrove swamp at Tagus Cove, Albemarle Island, Jan. 24, 1899. Above dark brown with an olive tinge on the rump; all of the feathers of the dorsum with narrow pale olive-grayish edgings; wing and tail feathers lighter, more smoky-brown; lores, sides of head and under parts dirty buff-gray; brownish-buff on the sides and flanks; lores spotted with brown; feathers of the breast and sides with dark brown central areas forming spots of the same color. Tips of the greater and the middle wing coverts rather indistinctly brownish-rufous, forming two inconspicuous cross bands. Under wing coverts grayish; under tail coverts brownish-buff with pale grayish edgings. Under surface of wing and tail feathers grayish-brown. Bill black. Feet dark brown. Length 123 millimeters, wing 72, tail 48.5, culmen 15, gonys 8, width of bill at base 6.5, depth of bill at base 9, tarsus 21.5.

There is a slight variation in the paleness of the under parts in different specimens of adult males, some being slightly paler than the *type*. Some also have a slightly more olive tinge to the plumage of the back. There is present in a few specimens a very distinct gray superciliary stripe ending behind the eye above the auricular region; in others this stripe is less distinctly marked or entirely absent. There is no distinguishing difference between the Albemarle and Narboro specimens.

Adult Female. — Female specimens having the plumage very much worn are almost identical in coloration with the males, but generally have fewer and smaller spots below. Above, the plumage is blackish on the head, almost pure olive-brown on the back, with the central areas of the feathers darker. Wing and tail feathers dark brown with olive-buffy edgings.

There is considerable variation in the color of the adult females. Some are, as described above, almost exactly the same as the males, but others have the lower parts plain buff-gray with no spots whatever.

Immature Males and Females. — Feathers of the head and back with blackish centers and olive-yellowish borders, on the head the black predominates, on the rump the olive-yellow, on the back the two are present in almost equal proportions. Wing and tail dark brown with buff edgings to the feathers; these edgings are widest and most conspicuous on the tips of the greater and middle wing coverts. Under parts similar to the adult male, having the same spots, but generally paler. Bill dusky or brownish above, pale brown or yellow below. Feet dark brown.

Still younger birds (represented only by males in our collection) are colored like the last but have no spots on the under surface, being plain dirty grayish below with a buff tinge, especially on the breast and along the sides.

We have no females of this stage but it is to be supposed from analogy that they do not differ from the males.

The extent of the olive coloring on the upper parts varies according to the abrasion of the plumage. We have no specimens of this species in the purely olive and yellow plumage characteristic of Stage I, but since this plumage is well represented by *G. pallida* we may expect to find it present in *G. heliobates.*

Rothschild and Hartert[1] make the following remark concerning *Geospiza pallida:* "The birds which are olive and buffish yellow below are immature ones, but it is somewhat puzzling to account for the distinct blackish brown stripes on the lower throat, chest and sides of the body in some of them. Neither the apparently most adult ones, nor the most yellowish, and therefore, according to our view, youngest of the series, have these stripes well developed." The facts of the case are as follows (applicable to either species of the subgenus): (1) The youngest birds of each sex are unspotted below; (2) older immature birds of both sexes have the lower parts profusely spotted, in some cases even more so than in the adults; (3) adult males are generally more or less spotted below; (4) adult females may be spotted below or they may be entirely plain there. The apparent incongruity pointed out by Rothschild and Hartert of some of the females losing their spots in maturity may be explained as follows: The indi-

[1] Novitates Zoölogicæ, VI, p. 166, 1899.

vidual feathers of the spotted regions of both immature and adult birds are pale slaty-gray basally; toward the tip is an arrow head shaped spot of dark brown with the apex directed toward the distal part of the feather; beyond this and forming the exposed margin of the feather is a buffy-gray area. The youngest birds, represented by the olive and yellow specimens of *G. pallida* have no brown spots on the feathers of the lower parts. Our specimen is moulting. Hence, *the spotted plumage is obtained by a moult involving a change in the color of the feathers.* The individual feathers of the adults that are plain below and of those that are spotted below are the same in color, but those that are unspotted are new, and show no signs of being worn, while those of the spotted birds are so greatly worn that nearly all the pale marginal part has been lost. Hence this difference in the general coloration of the birds is not one of an actual difference in the color of the feathers, but is a difference of the degree of abrasion of the plumage.

The immature spotted birds have the plumage very soft and lax, and the tips of all the feathers are rough and ragged as if much worn away. We have no specimens of this age having a fresh plumage, but it is evident that if the feathers of the worn birds were entire the brown spots below would be concealed, and then immature birds would present the same two phases as do the adults. All of our immature spotted birds are moulting so that between this stage and the adults a moult intervenes.

Hence there is in *Geospiza pallida* and *G. heliobates* no real color difference between the males and the females. Immature birds in the second plumage, *i. e.*, in Stage II, differ from the adults only in having the bill paler in coloration — brownish above and yellow below; in the plumage being softer and more lax, and in possessing wider, more distinct and more buffy wing bands formed of the pale edgings of the middle and greater coverts. This latter character distinguishes birds of this stage in all the subgenera and may be regarded, when combined with a non-olivaceous plumage, as diagnostic of Stage II. Hence between Stage II and the adults a moult intervenes, *but this moult involves only a slight change in the color of the plumage.*

In its habits *Geospiza heliobates* is the most interesting species of all the *Geospizæ*. It inhabits exclusively the mangrove swamps and feeds on insects. Whether it occurs on other islands besides Albemarle and Narboro we do not know. These swamps in many places consist merely of a narrow fringe of trees bordering shallow lagoons that run inward from the shore; but in other places, such as at Turtle

Point, Elizabeth Bay and Villa Mil, Albemarle, and along the east shore of Narboro, depressions of the surface of considerable extent lie a short distance back from the shore and these fill up with water at high tide, but have generally no visible connection with the ocean. At such places there occur large, dense groves of the mangrove tree and of another tree, *Avicennia*, which is always associated with it. At high tide the bases of these trees are covered several feet in depth, while at low tide the floor of the swamp is generally exposed except for scattered pools of water. It is only in the denser, interior parts of such groves as these that *Geospiza heliobates* is found. The birds seldom come out to the edge of the swamp, but they may easily be taken if one can find a clear space near the center of the grove. They are not timid or wary, but seem simply to prefer the denser and more shaded parts of the swamps. Their food consists entirely of insects which they obtain under the bark of the trees.

The notes of this species are as distinctive of it as is its habitat. We first heard the birds in January in the grove at Turtle Point, just north of Tagus Cove, on Albemarle. The song resembled *tür-tür*, *tür-tür*, *tür-tür*, the set of two syllables being generally repeated three times in succession, although sometimes more and sometimes only twice. The sound was varied somewhat and often resembled *twĕr-twĕr*, *twĕr-twĕr*. The notes are uttered rather loudly and have a very striking sound when heard issuing from the depths of a dense and apparently otherwise uninhabited grove. The birds seem to utter the notes almost constantly, and their presence and location in a swamp may always be known by their song.

We observed the species in the swamps of the east shore of Narboro during January, March and April, and did not perceive any difference between the habits or notes of the birds here and those at Turtle Point, Albemarle. The species was also observed in two large groves situated two or three miles apart, on the north shore of southern Albemarle, a few miles west of Elizabeth Bay. It was at once apparent, however, on listening to the birds of these swamps that their song differed from that of the Tagus Cove and Narboro birds. Instead of each set of notes in the song consisting of *two* syllables, it consisted of *three*. Each trisyllabic set was repeated two or three times just as with the others. The song, hence, resembled *tür-tür-tür*, *tür-tür-tür*, *tür-tür-tür*. Each swamp was visited twice; the birds were not scarce in either, and only now and then were bisyllabic sets heard. We visited the Turtle Point swamp again in March and the birds here were singing, as before, their bisyllabic song.

Besides the song just described the species has several ordinary notes. One resembles *check*, the *k* sound at the end distinguishing it from the notes of other *Geospizæ*. The vowel sound of this may be varied to *chŏŏk*, but the terminal *k* is retained. When hopping about they also utter a very low sound resembling *cheep*. Another common note very characteristic of the species, and one by which it may readily be known, is a rather harsh, prolonged sound, having *ĕ* as the vowel and the stress declining toward the end.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza heliobates*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
4491	Narboro.	♂	137	69.5	44.5	15.5	8.5	7	9.25	11	21.5
4492	"	"	132	73.5	46	15.5	8.25	7.5	8.5	10.5	21
3896	"	"	128	72	47	15	8	7	8	10	23
4109	"	"	127	71	49	15	8	7	9	10.5	22
4479	"	♀	130	70.5	40.5	15	8.3	7	9.5	10	21.5
4496	"	"	157	71	40.5	15.5	8	7	8.5	10.5	20.5
3911	"	"	133	73	53	15.3	8	7	9	11	23
4186	Albemarle.	♂	123	72	48.5	15	8	6.5	9	10.3	21.5
4161	"	"	126	70	48.5	15	8	7	8	11	21.5
4226	"	"	133	71.5	45	15.5	8.5	6.5	8	10.5	23.5
4266	"	"	127	69	39	15	8	6.5	8	10.5	21.5
4166	"	"	122	71	42	15	7.5	6.7	8.3	10	21.5
4124	"	"	128	72	43	15	8	6.5	8.7	10	21.5
4122	"	"	125	73	43	15	7.7	7	9	10	22
4130	"	"	129	74	45.5	15	7.7	7	8.5	9.5	22.3
4173	"	"	128	73	50	15	8	6.7	8.3	10	23
5142	"	♀	137	67.5	46	15.5	8	7	8	10.5	20
4249	"	"	132	69.5	42.5	15.3	7.5	6.7	8	10	22
4157	"	"	138	71	44	15	9	7	9	11.5	22.5
4177	"	"	112	70	42	14.5	8	6.7	7.7	10	21
4213	"	"	142	70	42.5	15	8.7	6.7	8	11	21.7
4242	"	"	136	68	41.5	15	8.5	6	7.5	10	21
4138	"	"	120	70	45	14	8	7	8.7	10	22
4135	"	"	125	69	46	15.3	8	7	9	10.5	21.5
4192	"	"	122	68	44	15	7.7	6.5	8	9.7	22
4146	"	"	123	69	51.5	15	8	7	8.7	10.3	22

We know nothing concerning the breeding habits of the species. The nesting season apparently does not begin till after March. It is still to be determined, also, whether the bird occurs in the mangrove swamps of other islands such as Indefatigable.

There are in the collection seven adult males, seven adult females, five immature males and one immature female from the mangrove swamp at Turtle Point north of Tagus Cove, Albemarle, taken in January; two adult males, two adult females and one immature male from the swamps at Elizabeth Bay, Albemarle, taken in February; four adult males, two adult females, one immature male and five immature females from the mangrove swamps on the east shore of Narboro Island, taken in January, March and April; and one adult female from Tagus Cove, Albemarle, taken in June.

We have examined also specimens of this species in a collection belonging to Captain W. Johnson, of San Francisco, collected in 1900 and 1901 by Mr. G. M. Green, of San Francisco. The specimens are from the mangrove swamps at Tagus Cove, Albemarle, and also from the mangrove swamps on the southeast part of Albemarle, abreast of the Crossman Islands. They are exactly the same as our birds from Tagus Cove, Elizabeth Bay and Narboro. Mr. Green obtained one specimen of *Geospiza pallida* from the eastern side of the mountain south of Perry Isthmus.

In the preceding table No. 4186 was taken mated with No. 4138.

Subgenus **Camarhynchus** Gould.

Camarhynchus GOULD, Proc. Zool. Soc. Lond., p. 6, 1837. (Type *Camarhynchus psittacula* Gould.)

Adult males with the back, head, throat and breast blackish. Sexes dissimilar. Female never blackish. The young resemble the adult female. Bill conical with the culmen strongly curved.

The males of this subgenus go through Stages I to V. This is an advance of two stages beyond the stage attained by the males of the last subgenus. The female remains in Stage III. Birds in Stages I and II have the bill yellowish. In the higher stages the bill is generally black.

There is but slight variation in the shape of the bill. The species can be most naturally arranged in a series graded by the size of the bill, beginning with the smallest billed form and ending with the largest. Among the specimens there is considerable variation in color, but it is probable that the males of all the species eventually attain the stage in which the entire upper and fore parts are blackish, although such forms have not been reported for all the species. But many are rare and black males are unknown only in the rarer species.

55. THE GEOSPIZA PROSTHEMELAS SERIES.

55*a*. GEOSPIZA PROSTHEMELAS PROSTHEMELAS (Sclater and Salvin).

Camarhynchus prosthemelas SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, fig. 4, 1870 (*type*, from Indefatigable Island). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 563, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 485, 1901.

Geospiza prosthemelas ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 169, 1899.

Range. — Narboro, Albemarle, James, Duncan, Jervis, Indefatigable, Charles, Gardner (near Charles), Barrington and Cowley.

Adult Male. — Cat. No. 4536, Leland Stanford Jr. University Museum; James Island, April 21, 1899. Head and neck all around and breast black. Back and upper surface of wings and tail dark dusky brown. Rump and upper tail coverts paler brown. Belly and under tail coverts white; sides and flanks brownish; lower part of breast white, streaked with black. Lower surface of wings and tail grayish-brown. Under wing coverts dusky-gray anteriorly, whitish posteriorly. Bill black. Feet dark brown. Length 105 millimeters, wing 63, tail 38, culmen 10.7, gonys 5.7, width of bill at base 6.3, depth of bill at base 8, maxilla from nostril 7, tarsus 20.5.

There is a considerable amount of variation amongst the fifteen specimens of adult males in the collection, specially in the coloration of the lower parts. Some have the back and upper surface of the wings lighter than in the one described, contrasting more strongly with the black of the head. The feathers of the throat and breast may have only the central areas black, the marginal parts being white. In some not only the belly but the lower part of the breast and the sides are white, the sides being streaked with brown. Still others have almost no dusky below, except on the throat, where the central areas of the feathers are black, the general color of the under parts in such specimens being yellowish-olive, shaded on the breast and sides with buff. The top of the head may be black with narrow olive-yellowish edges to the feathers, the back, wing- and tail-coverts olive-brownish, with the central areas of the feathers darker, the wing and tail quills brown with yellowish-olive edgings. The bill in such specimens is entirely black, indicating that the birds are adults. Since comparatively few of the males have purely black heads, we may assume that the acquisition of this character is rather late in the life of the bird.

Adult Female. — Cat. No. 4372, Leland Stanford Jr. University Museum; Tagus Cove, Albemarle, March 18, 1899. Feathers of the upper parts dark brown centrally, with yellowish-olive borders narrowest on the head and widest on the lower back and rump. Wings and tail dusky-brown, the feathers edged with yellowish-olive. Lower parts dirty buffy-gray, whitish on the belly. Obsolete streaks of brown on the breast and sides. Bill black. Feet brownish-black.

The streaking of the under parts and the proportion of olive and brown on the back in adult females varies, but such differences are apparently due to the degree of abrasion of the feathers. Some of the females have a pale superciliary stripe, a character of the young of *Camarhynchi* and adults of *G. pallida*.

Immature Males and Females (Stage II). — Upper parts blackish and olive, the black occupying the central areas of the feathers and the olive the edges. In some the olive predominates, in others the black. Under parts buffy-grayish, in older specimens streaked with brown in the breast. Middle and greater wing coverts with wide buffy tips forming two bands across the wing. Bill pale yellowish. Feet brown.

Young Males and Females (Stage I). — Above olive-brownish, the brown color occupying the central areas of the feathers, the edges of the feathers yellowish-olive, this color often almost concealing the darker central color. Wings as in older specimens. Below pale yellowish-olive or buff, obscurely streaked on the breast and sides with brown. A yellow superciliary stripe.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza prosthemelas prosthemelas*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
4427	Narboro.	♀	106	57.5	39.5	11	6	6.5	8	7.5	20.5
4317	Albemarle.	♂	115	62	38	11.5	6	6	8.5	7.5	20
4396	"	"	110	61	36	11	5.5	6	8	7	20
4246	"	"	113	61	39	10.7	5.5	6.5	8	7	20.5
4310	"	"	121	61	39	11.5	6	6.5	8.5	8	20.5
4327	"	"	110	64	37.5	11	5.7	6.5	8.3	7	20.7
4362	"	"	116	60	39	11	5.5	6.3	8	7	20
4257	"	"	113	62.5	41	12	5.5	6.5	8	7	21
4105	"	"	110	62	44	11.3	5.7	6.3	8	7	20
4234	"	♀	117	60	43	11	5.3	5.5	7.7	7	19.5
4155	"	"	111	58	42	11	5.5	6.3	8	7	19
4318	"	"	116	60.5	33.5	11.5	5.5	6.5	7	7	19.5
4268	"	"	111	61	37	10.5	5.3	6	7	6.5	20
4372	"	"	110	61	37	10.5	5.3	6.5	8.5	7	19
4536	James.	♂	105	63	38	10.7	5.7	6.3	8	7	20.5
4544	"	"	112	62	36.5	11	5.3	6.5	7.7	7	19.7
4509	"	"	110	63.5	45	11	5	6	7.5	6.7	20
	"	"	115	62.5	39	11	5.3	6	7	6.5	20
4532	"	"	106	64	46	11.5	6	6.3	7.3	7.7	20
4527	"	"	110	62	42	11	5.3	6	7.5	7	19.5
4605	"	♀	111	56	38	11.5	5.5	6	7.5	7	18.5
4554	"	"	104	60	41	11	5.3	5.7	8	7	19
4739	Charles.	♂	115	62	40	12	5.7	6.5	8	7.5	18.7
4727	"	"	115	62	39.5	11.7	5.5	6	8.5	7.3	20
4732	"	♀	120	58.5	38	11.3	5.5	6	7.3	7	19
4741	"	"	110	60	35	11.5	5.5	6	7	7	20

On these olive-yellowish specimens there is not enough brown below on the feathers to give the color of the spotted immature form merely by a wearing away of the paler marginal parts of the feathers. Hence, there must be, as in the case of *G. pallida*, a moult intervening between the olive-yellow stage and the spotted stage involving a change in the color of the feathers. When feathers are acquired having large subterminal brown spots the olive above and the yellowish below may yet, however, be indefinitely retained through not being worn off so as to expose the brown.

Our specimens were taken at Iguana Cove, Albemarle, in December and March; at Tagus Cove, Albemarle, in June; on James in April, and on Duncan and Charles in May.

This is the smallest species of the subgenus *Camarhynchus* and one of the smallest of the *Geospizæ*, being about the same size as *G. fuliginosa*. The bill is nearest in shape to that of the subgenus *Geospiza* and probably represents the first step in the bill variation along the *Camarhynchus* line.

The following two pairs of specimens were taken mated with each other: Nos. 4246–4268, 4532–4554.

55*b*. GEOSPIZA PROSTHEMELAS SALVINI (Ridgway).

Camarhynchus salvini RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 364, 1894 (Chatham Island), and XIX, p. 561, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 486, 1901.

Geospiza salvini ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 169, 1899.

Range. — Chatham.

This form is very close to *G. p. prosthemelas*, averaging slightly larger with a heavier bill, approaching *G. paupera* in size.

The collection contains seven adult specimens from Chatham taken in May. Five are apparently adult males, one of which has the head and throat black, but the color does not extend so far down on the chest and sides as it does in most of the adult males of *G. p. prosthemelas*. The other males, apparently immature in plumage, are streaked below anteriorly, being in the plumage described as *adult* by other authors. Our specimens are no more olivaceous than those from Albemarle, but are considerably more so than those from James.

The Charles Island specimens of *G. p. prosthemelas* is intermediate in size between *G. p. salvini* and *G. p. prosthemelas* of the other islands, although some specimens from most of the islands within the range of the latter species are equal to *G. p. salvini* in size.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza prosthemelas salvini.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4794	Chatham.	♂	125	66	40	12	6	6.7	8.5	7.3	21.5
4823	"	"	123	69	40	12.5	6	7	9.3	8.3	21.5
4711	"	"	122	62	39	13	6.5	6.5	8	8.5	21
4802	"	"	124	63	39	12.5	6.3	6.7	8.7	8	21.3
4710	"	♀	115	59	35	11	6	6.3	8	7	20.5
4708	"	"	122	62	37	12	6.3			8.5	20.5

56. GEOSPIZA PAUPERA (Ridgway).

Camarhynchus pauper RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 111, 1889, and XIX, p. 559, 1896; Bull. U. S. Nat. Mus., 50, Pt. 1, p. 483, 1901.
Geospiza paupera ROTHSCHILD AND HARTERT, Novit. Zool., III, p. 169, 1899.

Range. — Charles Island.

This species approaches *G. habeli* in the shape of the bill but it is much smaller and the adult males have the head and chest less blackish.

We have three specimens, two of which are adult males, but both lack blackish heads, being streaked on the throat and chest with dark brown. These were taken near the higher central part of the island to which they seem to be confined, none being seen near the coast.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza paupera.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width.	Basal Depth.	Maxilla from Nostril.	Tarsus.
4788	Charles.	♂	135	69	47	14	7.3	7	9.5	9.5	21
4740	"	"	118	70	39	13.3	6.3	7	9	8.5	22

57. GEOSPIZA HABELI (Sclater and Salvin).

Camarhynchus habeli SCLATER AND SALVIN, Proc. Zool. Soc., pp. 323, 325, fig. 3, 1870.— RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 555, 1896; Bull. U. S. Nat. Mus., 50, Pt. 1, p. 480, 1901.
Camarhynchus bindloei RIDGWAY, Proc. U. S. Nat. Mus., XVIII, p. 294, 1895, and XIX, p. 556, 1896.
Geospiza habeli ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 168, 1899.

Range. — Abingdon and Bindloe.

This species is intermediate in size between *G. psittacula* and *G. affinis*, but with a differently shaped bill. The bill is not so deep and considerably more elongate.

We have three adult specimens of this species from Abingdon and Bindloe. Immature birds common on Abingdon, but adults rare, only two having been seen. Only a few seen on Bindloe.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza habeli.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width.	Basal Depth.	Maxilla from Nostril.	Tarsus.
5200	Abingdon.	♂	130	71	39	16	8.5	8.5	11	10.5	22
5141	Bindloe.	"	140	69	44.5	16	8	8.3	11	10.7	23
5131	"	♀	144	73	46	16.5	7.7	8	10.5	10.3	21.5

58. GEOSPIZA INCERTA (Ridgway).

Camarhynchus incertus RIDGWAY, Proc. U. S. Nat. Mus., XVIII, p. 294, 1895 (James Island) and XIX, p. 560, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 482, 1901.

Geospiza incerta ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 168, 1900 (James and Duncan Islands).

Range. — James and Duncan.

This species was not seen by us. According to Rothschild and Hartert it is a very doubtful form and is probably not different from *G. affinis.*

59. GEOSPIZA AFFINIS (Ridgway).

Camarhynchus affinis RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 365, 1894, and XIX, p. 554, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 481, 1901.

Goespiza affinis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 168, 1899.

Range. — Albemarle.

This species is very similar in the shape of the bill to *G. psittacula psittacula.* All of our specimens are considerably smaller than the specimens of *G. p. psittacula*, but the two would probably be found to intergrade if a large series could be compared.

We have five specimens from Iguana Cove, Albemarle, two of which are adult males; the others have immature plumage, but have black bills and are of adult size. This species is not common at Iguana Cove and appears to be very rare about Tagus Cove, where only a single immature specimen was secured during several weeks of collecting.

In June these birds were heard at Iguana Cove singing a song which may be represented by *twĭr'e-twēē-twēē-ēē-ē.*

MEASUREMENTS OF *Geospiza affinis*.

Cat. No Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4335	Albemarle, Iguana Cove.	Ad. ♂	127	66	40	12	6.5	8	10.5	8.5	22
4041	" " "	"	127	69	47	14	6.5	8	10	9.3	24
5104	" " "	Im. ♂	130	67	42	13	6.3	7.7	10	8.5	20
3884	" " "	"	130	69	40	13.7	7	7.7	10.5	9	21.5
4071	" " "	"	120	68	44	13	6.3	7.3	9	8	20.5

60. THE GEOSPIZA PSITTACULA SERIES.

60*a*. GEOSPIZA PSITTACULA PSITTACULA (Gould).

Camarhynchus psittaculus GOULD, Proc. Zool. Soc., p. 6, 1837.—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 552, 1896 (James Island?); Bull. U. S. Nat. Mus., 50, Part I, p. 477, 1901.
Camarhynchus rostratus RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 363, 1894.
Camarhynchus compressirostris RIDGWAY, Proc. U. S. Nat. Mus., XVIII, p. 294, 1895, and XIX, p. 558, 1896.
Geospiza psittacula psittacula ROTHSCHILD AND HARTERT, Novit. Zool., VII, p. 167, 1899.

Range.—James, Jervis, Indefatigable, Duncan and Barrington.

Only four specimens of this species are in the collection, two of which are adults from James, one immature male from Barrington, and a young female from Indefatigable.

This species approaches nearer *G. crassirostris* in the shape of the bill than does any other of the smaller species of the subgenus *Camarhynchus*, but it stands much nearer *G. affinis*, which is perhaps only a smaller billed subspecies. In size and coloration it approaches closely to *G. habeli* but the bill is much thicker and the culmen more convex.

This is, apparently, a rare species throughout its range. It is found sparingly on James, where four were seen during two days of collecting.

MEASUREMENTS OF *Geospiza psittacula psittacula*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4528	James.	Ad. ♂	130	74	44	16	7.7	9	11.5	10	22.7
4473	"	"	125	75	45	16	8	8.5	12	10.7	24
4977	Barrington.	Im. ♂	129	69	40	15	7.3	8	12	10	22

60*b*. GEOSPIZA PSITTACULA TOWNSENDI (Ridgway).

Camarhynchus townsendi RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 110, 1890.
Camarhynchus psittacula RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 552, 1896.
Geospiza psittacula townsendi ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 167, 1899.

Range. — Charles Island.

We did not procure any specimens of this form. It was described from Charles by Ridgway in 1890, but in 1896 included by him under *G. psittacula.* In 1899 Rothschild and Hartert doubtfully based the subspecies *G. psittacula townsendi* on four specimens from Charles.

61. GEOSPIZA CRASSIROSTRIS (Gould).

Camarhynchus crassirostris GOULD, Proc. Zool. Soc. Lond., p. 6, 1837 (Galapagos Islands). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 551, 1896.
Camarhynchus variegatus SLATER AND SALVIN, Proc. Zool. Soc. Lond., pp. 323, 324, 1870. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 549, 1896.
Geospiza crassirostris ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 166, 1899.
Platyspiza crassirostris RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt 1, p. 474, 1901.

Range. — Charles, Chatham, Indefatigable, Jervis, James, Duncan, Albemarle, Narboro, Abingdon and Bindloe.

This is the most abundant and widely spread species of the subgenus *Camarhynchus*, and, as do the other species of the same group, it inhabits the moister and more wooded regions of the Archipelago. We found it common on the higher parts of Narboro, at Iguana Cove on Albemarle and on James. It is also common at the eastern end of south Albemarle.

In size and proportions of the bill *Geospiza crassirostris* stands apart from the other species of *Camarhynchus*, being much larger and having a much thicker and wider bill, it having been made by Ridgway, on account of this last character, the type of a separate subgenus, *Platyspiza.* In coloration it resembles the smaller species, but the males are more olivaceous and not so extensively blackish anteriorly and the females are more streaked below.

On the south side of Narboro, at an elevation of about two thousand feet, this species was found nesting in April. A nest containing four incubated eggs was taken April 5 in the branches of an acacia bush three feet above the ground.

This nest is ovate in shape, the lower end being the larger, covered above, and has the entrance in one side above the middle. It is composed of small, dry, flexible, tendril-like twigs of some vine, woven all through which are mat-like masses of a yellowish (when dead) lichen. The height of the nest is 150 millimeters, and the width at the entrance is 120 millimeters. The entrance is ovate with the larger end below; the vertical diameter is 65 millimeters, the transverse 50 millimeters. There is no special lining to the nest. The floor is very compact and hard.

The eggs are about the size and shape of those of *G. strenua* but differ somewhat in coloration. The ground color is pale greenish-white, marked chiefly about the larger end, but not in the form of a wreath with brownish, chestnut, umber and lavender. The darker markings are confined to the apex where they sometimes form short scrawly marks. One of the specimens lacks the darker markings of the large end and is quite indistinguishable from specimens of *G. strenua.* Three of the eggs measure 24 × 17, 23 × 18, 24 × 17.

The song of this species is very different from any of the typical *Geospiza* songs. It was heard only on Narboro and sounded like *chĕr-kĕ-rēē-zēē-ēē-ē.* The song begins low and is gradually brought up to a climax at the finish.

MEASUREMENTS OF ADULT SPECIMENS OF
Geospiza crassirostris.

Cat. No. Stan Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4443	Narboro.	♂	166	77.3	56	15	7.3	9.3	11.5	10	24.5
4421	"	"	154	81.3	52.5	14.7	7	9.5	12.5	10	27
4452	"	"	161	77	52.5	14.5	7	8.5	11.7	9.7	26
4445	"	"	164	78	54	15.5	7	9.5	11.7	10	24.5
3878	"	"	155	83	48	17	7	10	12.3	10	28
4422	"	♀	158	76	53.7	15	6.7	8.7	11.5	10	24
4451	"	"	161	76	51	13.5	7	8.5	11.5	9.3	26.5
4454	"	"		77.5	51	14	7	9.5	11.5	10	27.5
4450	"	"	164	72	52.5	14.5	6.5	9.5	12.5	10	25.5
3972	"	"	157	78	53	16.5	7	9	12	10	25.5
3934	Albemarle.	♂	158	83	52	16.3	7	10	12.5	9.7	27
3954	"	"	163	85	54	18	7.3	10	13	11	29
4090	"	"	167	81	49	17.5	7	9.3	12.5	10	26.5
3935	"	"	158	82	55	17	7.5	9	12	10	26.5
3944	"	"	170	87	52	17.5	7.5	10	13	10	27.5
4331	"	♀	155	81	52.5	15.5	7	9.3	11.5	10.3	28
4589	James.	♂	166	84	56	18.5	7.3	10	13.7	11	29
4616	Duncan.	♀	156	80	54	17	7.5	10	12	10.5	23.5
4793	Chatham.	"	163	85	50	17	7.5	10	13	10	28.7
5278	Abingdon.	♂	163	84	53	17.5	7	10	13	11	26
5287	"	♀	160	77	56	16	7.3	9.7	12.5	10	27

The following numbers represent pairs taken mated: 4443–4451; 4421–4422.

Subgenus **Geospiza** Gould.

Geospiza GOULD, Proc. Zool. Soc. Lond., p. 5, 1837. (Type, *Geospiza magnirostris* Gould.)

Adult males almost entirely black, under tail coverts edged with whitish; sexes dissimilar; females never blackish; the young resemble the adult female; bill conical but varies greatly in size and proportions; culmen generally straight.

During their growth males of this subgenus go through Stages II to VI. There is never at any age any plumage resembling the yellowish-olive plumage of Stage I in *Cactospiza* and *Camarhynchus*. Young birds in the first plumage are in Stage II. The adult female is the same as in the two preceding groups.

The evolution of this subgenus is not so simple as that of *Camarhynchus*. *G. fuliginosa parvula* we take as the most generalized member of the group, partly because it is most convenient to form a series beginning with it, and also because it resembles in size and general proportions *Geospiza* (*Camarhynchus*) *prosthemelas* with which we started the *Camarhynchus* series. Starting with *G. fuliginosa parvula*, and constructing the series according to the size and shape of the bill, we can form a continuous line from *G. fuliginosa parvula* to the more slender billed varieties of the same species, and from these through *G. debilirostris* and *G. septentrionalis* to the more slender billed members of the subgenus *Cactornis*. In the latter subgenus there is again an evolution in the color, consisting of a farther advance in melanism affecting the young of both sexes and the adult females. From *G. fuliginosa parvula* also a second line branches off in the opposite direction with regard to the size of the bill, *i. e.*, instead of becoming longer and more slender, the bill becomes proportionally larger and thicker at the base. This series begins with *G. fortis fortis*, runs through the other varieties of the same species, and then through *G. darwini* and *G. strenua* to *G. magnirostris*.

The species *G. conirostris we place in the subgenus Cactornis*. This is contrary to any disposition of it made by other authors, but the species have heretofore been grouped solely according to the shape of the bill. This, we think, is certainly a mistake, for the color is so characteristically different in the four groups as we here give them, and manifestly so much more constant than the shape of the bill, that we feel confident in relying on it as being a more important character for classifying the members of the genus. However, the bill in *G. conirostris propinqua* almost grades into that of *G. scandens* *rothschildi*, so that there is scarcely a break in the bill series of *Cactornis* even when *G. conirostris* is included in it.

62. THE GEOSPIZA FULIGINOSA SERIES.

This series comprises all the smaller billed forms of *Geospiza*. Under it we include the subspecies *G. f. parvula*, *G. f. fuliginosa*, *G. f. minor*, *G. f. acutirostris* and *G. f. difficilis*. It is represented on every island of the archipelago except the two most northern and smallest ones — Wenman and Culpepper. The bill varies within the following limits: Culmen 12–15.5, width of bill at base 6.3–8, depth of bill at base 6.5–10.

The species is the most abundant in individuals almost everywhere that it occurs, as well as the most widely distributed.

62*a*. GEOSPIZA FULIGINOSA PARVULA (Gould).

Geospiza parvula GOULD, Proc. Zool. Soc. Lond., p. 6, 1837 (James). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 529, 1896.

Geospiza fuliginosa fuliginosa ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 161, 1899.

Geospiza fuliginosa RIDGWAY (not of GOULD), Proc. U. S. Nat. Mus., XIX, p. 526, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 504, 1901.

Range. — James, Albemarle, Narboro, Duncan, Jervis, Indefatigable, Seymour, Barrington, Charles, Gardner (near Charles) and Hood.

Most of the specimens referred to *Geospiza parvula* by Ridgway are undoubtedly simply small sized specimens of the same species that he called *Geospiza fuliginosa*. Rothschild and Hartert state that "the type of *G. parvula*, according to Darwin, had been collected on James Island." Hence the name *Geospiza fuliginosa parvula* (Gould) must be given to the representatives of *G. fuliginosa* inhabiting the islands given above, since these differ slightly as a whole from the representatives on Chatham to which the name *G. fuliginosa fuliginosa* (Gould) must be given.

The bill of *G. f. parvula* is shaped like that of *G. fortis* but is considerably smaller, the culmen averaging about thirteen millimeters, being always less than fifteen. The variety differs from *G. f. fuliginosa* in the shorter but less slender bill. Some specimens from the northern slope of Narboro have unusually slender bills which nearly equal in length those of the longest billed Chatham specimens.

This is the most abundant form of *Geospiza* in the archipelago. It outnumbers in individuals all the other species together almost everywhere that it occurs. On account of its being the most easily studied species, and also apparently the most generalized of the subgenus *Geospiza*, we give the following detailed descriptions of the different stages which were briefly outlined in the introduction to the genus. The birds in the first plumage are in Stage II, Stage I having been apparently crowded out of the life history in the subgenera *Geospiza* and *Cactornis*.

Stage II. Young Males and Females just out of Nest. — This stage represents the first phase of the plumage of birds of both sexes after leaving the nest and is characteristic of young birds of the first year during spring and summer. We have no specimens taken later than June, so we do not know when the change from this stage to the next takes place. Young birds taken in December and January are in Stage III.

Feathers all soft and lax. Top of head and back brownish or dusky, the feathers with buffy, sometimes with buffy-yellowish margins widest on middle of back and on rump. Wing feathers sooty-brown, all of them with buffy-yellow edgings, these widest and most yellow on the greater coverts, narrowest and grayer on the outer edges of the primaries. Upper surface of rectrices dusky-brown, higher than the wings, edged with olive-buff. Sides of head and lower parts grayish-buff, more or less spotted with brown, especially on the throat and breast. Some specimens are almost uniformly pale below; others are thickly spotted. Each feather below has the concealed basal part dark slaty-plumbeous, the marginal part grayish-buff and between these two colors an arrowhead-shaped spot of dark brown. The size and intensity of this spot varies; when small it is almost entirely concealed by the buffy marginal color, and when large it causes the conspicuously spotted appearance of some specimens. Lower surface of wings and tail brown, paler than above, the primaries and secondaries with pale grayish inner margins. Bill either plain pale yellowish or yellow with the upper mandible clouded with light brownish. Feet blackish-brown. Examples: Leland Stanford Jr. University Museum Catalogue Nos. 4349, 4539, 4541, Iguana cove, Albemarle, March; No. 4539, female, James, April; No. 4541, male, James, April.

Stage III (a) Young Males and Females of the Winter Months. — Young birds are mostly in this stage about Tagus Cove during December and January. When the plumage is attained we do not know, for we have no specimens taken earlier than the last of December.

Plumage compact and of the same texture as in adult birds, not loose and soft as in Stage II. Upper parts brownish. The central areas of the feathers dusky-brown, the marginal parts lighter brown, but not buffy 'as in Stage II; the pale margins narrowest on the head, widest on the rump. Upper surfaces of wings and tail sooty brown, somewhat lighter than the central parts of the feathers of the dorsum; the primaries narrowly edged with ashy-gray. The greater coverts rather widely edged with buffy-brown; secondaries and rectrices more narrowly edged with buffy-brown. The buffy edgings on the coverts are duller and not so conspicuously yellow as on birds in Stage II. Below pale grayish with a slight buffy tinge on the belly and sides, the feathers with subterminal arrowhead shaped brown spots producing a streaked or spotted appearance on a pale ground formed by the light marginal parts of the feathers. The spots most numerous on the throat, breast and sides; the middle of the abdomen plain. Under surface of wings and tail as in last stage. The bill may be entirely yellowish, entirely dusky-yellowish, brownish-yellow with dusky tip, or entirely brownish above and yellowish below or yellowish below with the tip dusky. Feet blackish brown. (Examples: Leland Stanford Jr. University Museum Cat. No. 3880, female, Tagus Cove, Albermarle, January; No. 4202, female, Tagus Cove, January; No. 4194, female, Narboro, April; No. 4194, female, Tagus Cove, January; No. 4106, Iguana Cove, December.)

(*b*) *Adult Females.* — In plumage the adult female belongs to Stage III, being almost indistinguishable, except by the color of the bill, from young birds in the stage just described. The females, however, differ from young birds in this stage in lacking the buffy margins to the wing coverts, these being narrowly margined with grayish-brown. The bill is in some cases perfectly black as in the male, but it generally has a distinct brownish color rather than black, and in breeding birds the lower mandible may be pale brownish. Feet blackish-brown. (Examples: Leland Stanford Jr. University Museum Cat. No. 4369, female, Tagus Cove, March; No. 4392, female, Tagus Cove, March; No. 4406, female, Tagus Cove, March; No. 4409, female, Tagus Cove, March — all taken mated with adult males.)

Stage IV. Immature Males. — In this stage the males begin to differentiate from the females in the color of the plumage. Birds in this stage are similar in general pattern of coloration to males in the last stage. They differ, however, in having the dusky areas of the feathers of the lower parts much larger, so that below the specimens appear covered with crowded brown spots, especially on the throat and breast. The belly is generally mostly free from spots, but both the belly and sides are strongly shaded with brownish-buff. The bill is generally black, sometimes entirely so, but generally somewhat paler beneath or with a pale spot on the gonys. Feet blackish-brown. (Examples: Leland Stanford Jr. University Museum Cat. No. 4072, male, Iguana Cove, December; No. 4075, male, Iguana Cove, December; No. 4104, male, Iguana Cove, December.)

Stage V. Immature Males (Older than the Last). — Head all around, throat and breast continuously black. Feathers of the back with dusky centers, but with paler brownish margins, the brown lightest and most extensive on the rump. Upper tail coverts same as feathers of back. Upper surface of wings and tail dusky brown, the primaries and greater wing coverts edged with pale grayish-brown, the secondaries and rectrices edged with light but not grayish brown, as are the feathers of the back. Lower surface posterior to the breast buffy-whitish, streaked with brown along the sides. Lower tail coverts buffy-whitish. Lower wing coverts grayish and dusky. Lower surface of wings and tail grayish-brown; the inner edges of the primaries pale grayish. Bill generally black, but may have some yellowish on either or both mandibles. Feet blackish-brown.

This stage in the subgenus *Geospiza* represents the adult males of the subgenus *Camarhynchus*, while Stage VI represents the advance of *Geospiza* and *Cactornis* beyond *Camarhynchus*. (Examples of Stage V: Leland Stanford Jr. University Museum Cat. No. 4101, male, Iguana Cove, December; No. 5087, male, Iguana Cove, June.) Birds in this stage are rather scarce, a fact perhaps indicating that the stage is quickly passed through.

Stage VI. Adult Males. — The most melanistic forms are colored as follows: General color black, deepest anteriorly. The basal concealed part of each feather pale slaty-gray, this color abruptly demarcated from the wide black marginal part; there is no trace anywhere of a paler brownish margin beyond the black. On the rump the black part of the feathers is narrower so that the color is easily exposed if the feathers are slightly disturbed. The primaries, inner webs of the secondaries, and the rectrices dusky-brownish, somewhat contrasting with the rest of the dorsum and the exposed parts of the secondaries. Under tail coverts margined on the exposed parts with pale buffy-white. Under wing coverts black. Under surface of wings and tail dark grayish-brown, on the wings contrasting strongly with the black of the under wing coverts. Bill always entirely black. Feet blackish-brown. (Examples: Leland Stanford Jr. University Museum Cat. No. 4187, male, Tagus Cove, January; No. 3938, male, Iguana Cove, December — these taken mated with adult females.)

This plumage is characteristic of adult males of all species of the subgenera *Geospiza* and *Cactornis* and represents the farthest advance toward complete melanism that any of the *Geospizæ* have reached.

There are all gradations between Stages V and VI. The black color invades the lower breast, sides and abdomen as the pale margins of the feathers disappear, the latter color remaining longest on the lower abdomen, flanks and under tail coverts, never entirely disappearing from the tips of the latter, and most of the blackest birds have the under tail coverts broadly margined with pale rusty or buffy. Also the primaries never become pure black, but in all cases retain a distinct brownish color.

Plumage of Nestlings. — Very young birds having yet no wing quills have four groups of very fine plume-like feathers on the head, two on each side. One group forms an oblique line on the dorsolateral aspect of the head extending from a point above, and a little back of the middle of the eye, backward and downward, ending a little below the upper level of the orbit and over the posterior end of the ear slit. The second group is situated on an oblique line on the lower part of the back of the head on a level with the ear; it is shorter than the upper, and extends from without downward and inward. On the body and appendages there are eight groups of these plume feathers, arranged in four pairs as follows: a longitudinal row on the posterior edge of the forearm, a transverse line across the back of the middle of the humerus, a transverse line across the back of the femur near its proximal end, a row along each side of the median line of the back on the position of the enlarged part of the dorsal pteryla of later stages. There is no plumage on the ventral surface of the head or body at this age.

The young wing quills, in nestlings a little older than those described in the last paragraph, are of a pure bluish-slate color, tipped with pale buffy-white. The greater coverts of the primaries are the same as the quills. The middle and lesser primary coverts and all the secondary coverts have long reddish-brown terminal parts. The tips of all the coverts, especially those of the secondaries, bear long and very fine buffy plumes. In older specimens not only the wing coverts but also the feathers of the middle of the back are strongly tipped with reddish-brown.

Pterylosis. — The following description of the pterylosis of *Geo spiza fulginosa* applies to all members of the genus. The dorsal pteryla runs down the back of the neck as a very narrow band, being much narrower than the cervical part of the ventral pteryla. At the middle of the back, however, it expands greatly, forming a large oval patch which extends posteriorly to the anterior part of the lumbo-sacral region. Here the dorsal pteryla again contracts into a narrow median band which extends along the middle of the rump to the oil gland, expanding very slightly back of the acetabula. The ventral tract forms anteriorly a single band along the upper and middle parts of the ventral side of the neck. A little below the middle of the neck it bifurcates and each half runs outward and posteriorly on the side of the neck to the shoulder. Here it gives off laterally a shoulder band which in turn divides into the alar and humeral tracts. The main pterylæ continue posteriorly on the sides of the breast. The two diverge considerably, each becoming wider and extend along the side of the abdomen to the knee. Here each contracts again and runs down the front of the abdomen to near the anus, the two converging once more.

Color of the Bill. — The general development of the color of the bill in the male is as follows: early in the life of the bird, in the beginning of Stage II, both mandibles of the bill are yellow. Soon the upper begins to become clouded with dusky, the yellow remaining longest as a spot on the culmen generally near the tip of the mandible. When the upper mandible has attained this coloration the lower begins to become dusky, the dark color beginning at the tip and later spreading over the whole mandible, the yellow remaining longest as a spot on the gonys. The dark color of both mandibles is at first brownish, later it becomes black. The color is developed in the same manner on the bill of the female, but, the acquisition of the dark color takes longer and the final tone is dusky-brown rather than black.

The development of the black color on the bill and on the plumage do not always progress at the same rate. Often birds may be found with perfectly black plumage, but with the bill partly yellow; the lower mandible may be even entirely yellowish. In birds only partly white below, the bill may be slaty-brown above and yellow below.

Relationship between Color of Bill and Plumage, and Maturity. — There is apparently no seasonal change of plumage in the males — adults being equally black, whether taken in January, March or June. The height of the nesting season is in March in most places.

The following observations on the development of the color of the plumage and bill are based on specimens taken at Tagus Cove, Elizabeth Bay and Iguana Cove, Albemarle, during the months of January, February, March and June. We were not at the same locality anywhere else long enough to make observations on these points elsewhere. From Tagus Cove we have twenty two specimens of males taken in January, two taken in February and fourteen taken in March.

All of the clearly immature birds occur in the January and February lot. Most of the January specimens are in the brown plumage, Stage III, four are in Stage IV and two in Stage II. Both of the February specimens are in Stage V. Nearly all of the March specimens are in Stage VI or in a condition intermediate between Stage V and Stage VI. This is the typical breeding plumage. One specimen, however, is in Stage V and was taken apparently mated with a female. Another specimen taken mated with a female is actually in Stage III! This, then, shows that, although the black or nearly black plumage and sexual maturity generally coincide, yet the melanistic phase may be retarded. It is also evident that *the males do not become entirely dusky until the end of the first year.*

All the March males have the bill perfectly black. Few of the others, however, have the bill entirely black, most of them having some remnant of the yellow on the lower mandible, either as a definite spot near the tip of the gonys or as a diffusion over the base. Some even with purely black plumage have the lower mandible entirely yellow. Hence *the bill does not become entirely black until the end of the first year and may remain partly pale longer than the plumage.* The breeding male in plumage Stage III has the bill entirely black, thus resembling exactly the adult female. Hence, sexually mature males may have immature plumage, but we have no case of a breeding bird having an immature bill.

From Iguana Cove we have sixteen male specimens taken in January and two taken in March.

Of the January birds only four are in Stage VI, eight are in Stage V and IV or intermediate between the two, and three are in Stage III. Yet all of these birds except one (this one in Stage III) were apparently breeding males. The nesting season had here begun at this season and the males in all stages of plumage had the testes enlarged as if breeding. The breeding season at Iguana Cove begins about two months in advance of that at Tagus Cove. This difference is due most probably to the much greater humidity of Iguana Cove as compared with Tagus Cove. The breeding season lasts at least as long as it does at Tagus Cove, *i. e.*, until April. Hence, it is probable that birds hatched here during the last of a season begin breeding at the first of the season in the following year when they are only ten months old, being in Stage V or even IV, and, hence, before they have had time to acquire the full black plumage.

We have thirteen male specimens taken during the second half of February at Elizabeth Bay. The males are mostly in the black plumage and have black bills. Two are intermediate between stages V and VI. One is in Stage V but has the bill entirely black. The nesting season here had apparently just begun at this time. It is probable that it is of short duration as it is at Tagus Cove, and the birds have time to acquire the black plumage before they begin to breed.

There is a slight seasonal change in the plumage of the females due to the age and consequent abrasion of the feathers. Specimens taken in March compared with specimens taken in January average darker below with less of the pale color of the marginal parts of the feathers.

Only three of our specimens of females taken in March have perfectly black bills. In some cases the gonys is almost entirely yellowish and this is true of birds taken mated with males. Only two of the January specimens have dusky bills. Hence the bills of the females do not as a rule become black by the end of the first year, and apparently seldom become perfectly black, showing a tendency to remain, as does the plumage, in a non-melanistic condition. In this respect they differ from the males, which apparently regularly acquire black bills by the beginning of the breeding season.

Nature of the Change from one Phase of Plumage to the Next — Moulting. — The change in color of the *males* from the young to the adult consists not only of a spreading of the dark color from the head over the posterior parts, but also of a change from brown to black.

Of eleven breeding males taken at Tagus Cove in March three are in a plumage that could have been produced from the plumage of January birds in Stage V by abrasion of the pale tips of the feathers. The pale color is very conspicuous below on the belly, flanks and crissum, but less so than in typical examples of Stage V. The black of the other parts, especially of the back and rump is not intense as in birds most typical of Stage VI, but has a very distinct brownish tone. The tail and wing feathers are also much paler and more decidedly brownish than in the most melanistic forms. These brownish-black forms could not pass over into the purely black phase without a moult involving a change of color in the feathers, although they might be produced from Stage V simply through abrasion of the feathers.

We have one specimen, taken at Tagus Cove in February, which is in a stage intermediate between Stages V and IV. This specimen is moulting, but the new feathers coming in have the same pale edges and brown subterminal areas as the old ones.

Three specimens taken January 12 and one taken January 24, at Tagus Cove, all in Stage V or between this Stage and Stage IV, show traces of moulting, but none so much so as the February specimen. Any of these birds might attain the same plumage as the brown-backed, pale-bellied breeding birds of March through abrasion of the plumage involving a wearing away of the pale edges of the feathers.

There are three other birds from Tagus Cove taken in January in the brown-spotted phase, Stage III, which are also moulting. These, however, could not go over into Stages IV or V without a moult involving a change in the color of the feathers, for they are distinctly paler brown everywhere and not dusky. Another bird taken January 30 is dusky beneath but paler than specimens typical of Stage V, and has the bill pinkish-yellow clouded with dusky. It is moulting slightly.

There are in the collection sixteen male specimens taken at Tagus Cove in January. These vary from the purely black phase characteristic of Stage VI, to forms with dusky head, conspicuously brown backs and tail, pale rumps, and with much pale buffy-grayish on the edges of the feathers of the belly, flanks and crissum. One of these duplicates in coloration the palest of the breeding March birds. Among these dusky January birds, is one that has no pale color below except on the under tail coverts but has a few new feathers growing in; while several of those having pale bellies have many young feathers.

None of the specimens from Elizabeth Bay, taken in February shows any sign of moulting. Of thirteen males one is in Stage IV, two are in Stage V and several are in the brown-backed, pale-bellied breeding plumage intermediate between Stage V and Stage VI.

There are in the collection sixteen specimens from Iguana Cove taken in December, January and March. Only two of the December and January specimens show any indication of moulting. These are both in Stage IV; they have very much worn plumage and a few new feathers growing in. One of them has the lower mandible yellowish with black at the tip and base. The testes were enlarged as if the bird was breeding. The other has the bill almost entirely black with the exception of a yellowish spot on the culmen and another on the gonys. The testes of this one were somewhat enlarged. Hence, it appears that by the beginning of the breeding season, which here commences in January, most of the males have ceased moulting. The plumage of all the specimens is worn and does not have the appearance of having been newly acquired.

Most of the immature *female* specimens taken in January at Tagus Cove are moulting. Of the adult females only one is moulting — it has a few new feathers coming in on the back. Of the females taken in March only two (there are eighteen in all) are moulting — each of these having a few new feathers growing in on the dorsum. These two moulting adults were breeding since they were taken mated with adult males.

None of the Elizabeth Bay females, taken during the second half of February, is moulting, and only one Iguana Cove female, taken the last of December, is moulting. This latter is an adult, and, apparently, a breeding bird, and has a few new wing quills coming in.

The breeding (March) females from Tagus Cove have a different appearance from the immature females taken in January. They are much darker below, the brown color predominating, while in the January specimens the pale color predominates and the brown is almost restricted to the sides of the body and the fore-parts of the breast. In many cases it appears doubtful that the March phase could have been derived from the January phase simply by an abrasion of the feathers, for there is not enough brown on the feathers of the latter especially on those of the belly and lower breast, to produce so dark a tone as characterizes the March birds, even if the pale edgings were all worn off. This difference would, hence, indicate a slight change of color during the January moult which terminates during February.

The foregoing facts may be summarized as follows: during the time from December to February the males go through Stages III, IV and V, arriving at Stage VI by the first of March. In Stage VI they are at first, however, brownish-black instead of pure black. The females during the same time become slightly darker and acquire a larger proportion of brown on the plumage. Both males and females show all gradations of color from one phase of plumage to another, *i. e.*, there is no jump from one stage to the next as would be the case if one phase were due to a rapid loss of one set of feathers and a simultaneous acquisition of a new set. Corresponding with the gradual change in the appearance, which slowly leads from one stage to that following, is the fact that none of the birds that are moulting shows any extensive indications of doing so. In all cases the moulting process appears to be a gradual loss of old feathers and a corresponding ingrowth of new ones, for in no case are there more than comparatively a few new feathers to be seen growing in. The birds never appear denuded, and the total number of feathers appears to be always the same. (This does not apply to birds in Stage II.)

Along with the moulting of the feather there takes place a gradual change in the color of the feathers. The plumage becomes darker through the successive sets of feathers having not only more dark color but also a duskier shade of dark color and narrower pale edgings. In the male the color change is from light brown, through dark dusky brown to black; in the female from light brown to dark brown. The spreading of the dark color is due in part also to the wearing away of the light margins of the feathers, so that general color of plumage formed of old feathers is darker than that composed of new feathers. Hence, both males and females moult slowly and gradually from December into February, the new feathers having successively *more dark color on them*, and the dark color becoming successively *darker*, being always brown in the females but changing in the males from light brown, through dark and dusky-brown, to black.

Young birds taken at Tagus Cove in June are in Stage II. One male taken June 9 is in Stage V and is not moulting. We have no other specimens from Albemarle taken after the breeding season. Hence we do not know what phases of plumage the birds are in on Albemarle during the time from March till December. Birds taken on the other islands, however, during April, May and June are mostly either in Stage VI or in Stage II. We have twenty two males from Indefatigable and Seymour taken during the last of April and the first of May that are in Stage VI. One is in Stage V and has a few new feathers growing in on the breast. Several others are in Stages IV and III and most of these are moulting. Besides these there are numerous specimens in Stage II, birds just from the nest. From Charles we have two adult males in Stage VI, five adult females, and numerous young birds in Stage II. We have no material to indicate when the transition from Stage II to Stage III takes place. Nor do we know at what age adult males in Stage VI change from the blackish-brown phase to the purely black phase. The fact that many breeding males possess the blackish-brown plumage would indicate that the purely black plumage is not acquired until during the second year.

Habits, Song, Nests and Eggs. — *Geospiza fuliginosa parvula* is extremely abundant about Tagus Cove on Albemarle, living everywhere in the dry brush that covers the walls of the old tufa craters of this part of the island. The individuals commonly associate with one another in small flocks and often mix gregariously with the less abundant, larger-billed *Geospiza fortis*. Although their food consists almost entirely of seeds, yet many of the birds may be seen along the shore feeding among the rocks below high water. During the dry season great numbers of them collect about the holes of fresh water a short distance south of Tagus Cove. This is the only fresh water of this part of the island, and birds that do not visit it must depend entirely on dew for water. In the mornings they may often be seen taking dew baths, perhaps never having known the luxury of a running stream. During the middle of the day many of these birds may be seen with gaping mandibles, in evident distress from the heat and dryness. Habel thinks that a large number of them, especially young birds, perish from want of water. They feed on both seeds and insects, picking up anything they can find and swallowing with their food a large quantity of gravel. They most frequently pick up their food from the ground, and it is this habit alone which has gained for them their name of "Ground Finch"; for they never build their nests on the ground, and except when feeding they are nearly always in the bushes and trees. Furthermore, they pick many insects from crevices of the bushes, eat berries and devour large numbers of Lepidopteran larvæ during the rainy months of February and March. Although spiders are numerous, the Geospizas seldom molest them.

The birds are generally abundant wherever vegetation is found, and their range extends to the top of the mountain back of Tagus Cove, four thousand feet above sea level. Only a few, however, live in the mangrove swamps to the north of Tagus Cove, most of them appearing to eschew these dense, wet places, preferring the dryer, sunnier and more desolate brush-covered areas.

Our first visit to Tagus Cove was made during January and the first week of February. The breeding season was not yet on, but the males did a good deal of singing, although there was not much variety in it then. Their song at this time, however, is characteristic of them, and can be recognized as the basis of almost all their numerous songs of the breeding season. It consisted of three repetitions of two connected syllables and may be represented phonetically thus: *teur'-wēē*, *teur'-wēē*, *teur'-wēē*, the accent on the first syllable. The single bisyllabic set is the fundamental element of all their singing. The consonant sounds vary a great deal, but it is difficult to observe them accurately and impossible to represent them by the sounds of letters. Their vowels come more nearly within the range of alphabetical sounds. The first syllable varies from a *teur*-sound to what may be represented by a German umlauted *u*, thus *tür'-wēē*, *tür'-wēē*, *tür-'wēē*. Everywhere about the cove the birds could be heard uttering this song. It was varied in many ways, but each set seldom had more than two syllables. In some cases the vowel sounds were reversed, so that the song sounded like *tēē'-twür*, *tēē'-twür*, *tēē'-twür*. One bird was heard singing *tü'-dl*, *tü'-dl*.

When Tagus Cove was again visited (March 11 to 26), everything was greatly changed. Rains during February and the first part of March had caused a revolution in the vegetation, which was now green, in pleasing contrast with the former brown and barren aspect of the hills. The birds were in the height of their nesting season, almost all of the nests found containing either eggs or young birds. Everywhere the males were vigorously exerting their musical powers and the common song of January was replaced by longer and more elegant pieces of music, so that the *teur'-wēē* song was not nearly so prominent as before. The closest thing to it merely had the accent shifted to the second syllable, sounding like *teur-wēē'*, *teur-wēē'*. The song variety next removed consisted of a lengthening of the second syllable, so that it resembled *teur-lēē- - -ē'*, *teur-lēē- - -ē'*. Another song may be represented thus: *tew—twēē-twēē-twēē-twēē*. The *twee* syllable was generally repeated four times, but often only two or three times. The space between the first and second syllables was generally considerably greater than that between the others. No syllable had any special accent. One bird was heard singing with a great deal of force a song resembling *ēē'-zërt*, *ēē'-zërt*. Special stress was given to the first syllable which was also slightly elongated. A common song at this time sounded something like *tür-lēē'*, *tür-lēē'*. Another song resembled *tēē'-ŭl-tēē*, *tēē'-ŭl-tēē*.

During the breeding season the males sing almost continually and are constantly active. The females on the other hand, both when alone and when with their male companions, are very quiet and reserved, showing little excitement. They utter merely a single, low, prolonged note used by either bird of a mated pair as a call or an answer to the other when the two are feeding or hopping about in the bushes near each other. When a male is with his mate he is generally contented with flying or hopping about with her, making no demonstrations of his affection for her and giving no evidence of any unusual state of mind. It is when she is occupied with her domestic duties that the male gives vent to his emotions, pouring forth most lavishly all the songs of which he is capable. It must be said, however, that, although his efforts are good, his actual productions can by no means rank with those of even ordinary singing birds, and indeed anywhere else would scarcely pass for songs. One never hears from the Geospizas such songs as are uttered by the song-sparrow or house-finches.

The birds are scarce about Elizabeth Bay on Albemarle, for there is little vegetation here outside of the mangrove swamps, and, as said before, these salt swamps appear to be uncongenial to them. On the north side of Perry Isthmus, however, there is plenty of vegetation all over the side and about the base of the mountain there situated, and the birds were found abundantly at this place. We were here during February and it was noticed that *Geospiza fuliginosa parvula* uttered notes very strikingly different from anything heard elsewhere. The song was so very much like that of the swamp *Geospiza heliobates* that when we entered the mangrove swamp along the shore where the birds were singing, we supposed we were listening to this bird. Afterwards, however, a specimen in the act of singing the song was taken outside of the swamp and found to be *Geospiza fuliginosa parvula*. The song itself consisted of a repetition of a single note and resembled somewhat *t'wër-t'wër-t'wër-t'wër*. Each note had a double sound, the *t* being slightly separated, as if composed of a bisyllabic sound condensed into a single syllable. Three or four was the usual number of repetitions of the note.

During the time we were here the birds were nesting both in the mangrove swamps along the shore and in the trees and bushes inland. One male was noticed in a swamp reconstructing an old nest with material that he took from another old nest in a neighboring tree. While at work he constantly uttered in loud clear tones the song just described. He worked, however, very interruptedly, for he spent a great deal of time in flying about in a very excited manner from tree to tree, acting just as if he was living in a state of such happy expectation that he could scarcely contain his emotions. At intervals a female came around to inspect the nest. She was always very quiet and showed no excitement at all, very calmly examining the nest, but paying almost no attention to the male. She, however, or perhaps the delightful hope of her approval of the nest, was very evidently the sole cause of the male's exuberance of spirit. Whenever she appeared he flew about wildly, first to the nest and then to some neighboring branch and back again to the nest, all the time uttering with greatest energy the song described. Very curiously, however, he did not fly about the female nor keep close to her nor even look toward her more than in any other direction. Whenever he alighted anywhere he held his body in a depressed attitude and kept his wings rigidly half spread in a drooping oblique position, all the time turning partly from one side to the other. If the female went into the nest he went in also, or at least to the nest, and then either one or both of them uttered low elongated notes sounding somewhat like *chēē.........ēē*. They uttered this note a number of times while observed but always either when both flew to the nest together or when one was at the nest and the other flew to it. It was impossible to observe whether at such times both birds uttered the note or only one, but two voices seemed to be distinguishable.

The birds have a common note that they utter on ordinary occasions, such as when they are hopping about in the bushes or when feeding. This is a short, low simple *chick*-like sound. Besides this they have another, a more lengthened note, having a sort of broken sound. This they use on more special occasions — it is almost always heard when a male flies after a female, apparently both of them uttering it.

The song of the birds at Iguana Cove was first observed during the latter part of December. At this time they were occupied with nest building and numerous unfinished and many completed nests were found, but only a few of the latter contained eggs. A very common song resembled the *teur'wēē* song of Tagus Cove, it being bisyllabic, having a vowel sound in the first syllable resembling a German umlauted *u* and in the second a long *e*. The song may be represented thus: *tül'-wee*, *tül'-wee*, the sets being generally uttered twice, often three times, in succession. Sometimes the second syllable was repeated several times; one bird was heard singing thus: *tül-twee-twee-twee*, *tül-twee-twee-twee*. Another song heard resembled the first described, but had the accent on the second syllable: *tü-lēē'*, *tü-lēē'*. Again the vowel sounds were reversed and the song sounded like *tēē'-twür*, *tēē'-twür*. The same variations take place with this; one bird was heard singing *tēē'-twür-twür-twür*, *tēē'-* etc., in each set of this song, the accent being given to the first syllable. Another bird sang a song of two syllables, in each of which the vowel had the *ü*-sound, and the first syllable was much prolonged, thus: *tü . . . . ü-twür*. This was uttered either by itself as an entire song or was followed by *twee-twee-twee*.

These varieties of song were all uttered by males in full black plumage, the usual breeding age dress. However, a brown-plumaged bird was observed singing a song resembling *tü . . . . ul . . . . l-wee*, the first syllable being greatly prolonged, although varying considerably in length, while the second was shorter and abruptly higher in pitch. Another brown-plumaged bird was observed acting exactly after the manner of a breeding male. He was rapidly and excitedly uttering a song somewhat like *tü-wēē'*, *tü-wēē'*, *tü-wēē'*, and was amorously pursuing a second brown-colored bird, apparently a female, before whom he presented himself in a drooping attitude with spread wings. Several brown-plumaged males were shot which had the testes enlarged.

We visited Iguana Cove again during the first part of March. This time numerous sets of eggs, all well advanced in incubation, and several sets of young birds were found. Everywhere the males were singing continuously. Their song was even more varied than before, consisting in most cases of several syllables instead of two. One song resembled *tü wēē'-twēē-twēē-twēē*. The ordinary *tü'-wēē* song was heard, but it was not nearly so common as in December, while the songs with a greater number of syllables were much more common than then.

The same place was visited a third time early in June. The nesting season was now past and the birds were much less abundant on the flat to the east of Iguana Cove than during December and March, and but few were heard singing.

At Tagus Cove some fledglings were taken from the nest while the parents were absent. Both of the latter, however, soon came flying very excitedly about the place, keeping most of the time near the ground, repeating in rapid succession a short, sharp, *tweet*-like note. The young became very angry at being handled and uttered a a sound resembling *zēē''u*, *zēē''u*, *zēē''u*, etc. The long *e*-sound of the first syllable was somewhat prolonged and given a deep vibratory sound. Although the young birds were not yet able to fly, they uttered the notes in very resentful tones and bit savagely at the fingers of the person handling them.

Birds were observed on the Seymour Islands and the neighboring part of Indefatigable from April 26 to May 4. On South Seymour they were much more abundant than on North Seymour or on the part of Indefatigable visited. They were not nesting, but the males were singing a great deal, and most of the songs they sang were very noticeably different from the songs of the Albemarle birds. The song that they uttered most commonly resembled *teur'-lēē-hēē*, *teur'-lēē-hēē*, *teur'-lēē-hēē*. The first syllable of each set carried the accent, and the second and third syllables differed only in the initial consonant sound. The same individuals that sang this song often uttered the same syllables with the accent transferred to the second, thus: *teur-lēē'-hēē*, *teur-lēē'-hēē*, *teur-lēē'-hēē*. This song was almost as common as the other, and indeed a bird singing one almost always, sooner or later, changed to the other. Another song often heard sounded like *teur-lēē'*, *teur-lēē'*, *teur-lēē'*, *teur-lēē'*, nearly always consisting of four sets. This was similar to one of the songs of the birds at Tagus Cove on Albemarle, but the birds there seldom uttered more than two sets in succession. The Seymour birds were not heard to utter this song with the first syllable accented — a form of song so common with the Tagus Cove birds. Still another song resembled *tēē'-wēē-wēē*, *tēē'-wēē-wēē*, *tēē'-wēē-wēē*.

On Charles Island this species was very common. In going up the trail from Black Beach Landing to the higher central part of the island the birds were found to be much more abundant along the second half than lower down where other forms predominated. In fact, only a few specimens of this species were found below the spring on the trail, situated perhaps a third or more of the distance up, while from here to the top it was by far the most common *Geospiza* species. We were at Charles Island during the first of May. A very common song resembled *teu-wink'*, *teu-wink'*. The second syllable had a decidedly different sound from anything heard elsewhere. They also sang *skēē'-wee*, *skēē'-wee*, *skēē'-wee*, or something of this sort; it being much the same in character as the common *teur'-wēē* at Tagus Cove, differing from this conspicuously, however, in the consonant sound of the first syllable.

On Duncan Island this species was the only common *Geospiza*. It was abundant within the crater, but ouside of it was scarce.

We have eight nests of *Geospiza fuliginosa parvula* taken about Tagus Cove on Albemarle Island during March. They are all very similar and resemble in shape the nest of *Camarhynchus crassirostris* already described. All are large, having the longest diameter vertical, varying in height from one hundred and forty to two hundred millimeters, and in width from ten to twelve millimeters. The entrance is generally oval and mostly above the middle of the side, being generally about fifty by forty millimeters in dimensions with the longer diameter vertical. The nest is entirely and thickly roofed over above, and often the part above the entrance is almost overhanging. The front is generally more or less flattened. The nests are never suspended, being always supported from below, but may have accessory lateral braces. Nests from Tagus Cove and Iguana Cove, Albemarle, are composed of slender stems of small plants, stems of vines, grasses and bark of larger soft plants. Four nests have interwoven all through the coarser material numerous bits of cotton plucked from the cotton bushes, which are abundant at both places. The cotton in the nests is all in isolated heads detached from their stems. Leaves are very sel-

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa parvula*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
3995	Albemarle, Tagus Cove.	♂	112	62	42	12	6	6.7	8.7	8	18.3
3985	" "	"	115	65	46	13	6.5	6.5	8.5	8	19
3915	" "	"	112	62	38.5	12.5	6	6.5	8	8.5	18
3942	" "	"	—	64	—	12.5	6.3	7	9.5	8	19.5
3986	" "	"	110	63	42	13.3	7.3	6.7	9	9	19
3814	" "	"	110	64	46	14	7	7	8.5	9	18.5
4030	" "	"	115	63	41	13	6.7	6.5	9	9	18.5
3941	" "	"	105	63	41	12	6	6.7	8.7	8.5	18
4047	" "	"	120	65	48	13.5	6.7	7	8.3	8.5	20
4007	" "	"	111	63	38	12.5	6.5	7	10	8	19
4036	" "	"	120	65	40	13.5	6.5	7	9.5	8.3	19
4341	" "	"	120	61	44	13	6.5	6.7	8.3	8.3	18.7
4110	" "	"	120	63	42	13	7	6.7	8.3	8.3	19
4400	" "	"	112	62	44	12.7	6.3	7	9	8	20
4206	" "	"	112	64	45	13.5	6.3	7	9	8.5	18
4139	" "	"	115	63	42.5	12.7	6.5	7	8.5	8	19.7
4187	" "	"	112	64	42	12	7	6.5	8.5	7.5	19.5
4288	" "	"	—	62.5	41	13	6.5	6.5	8.3	8	20
4211	" "	"	126	62	45	14	7	7	8.5	9	20
4366	" "	"	—	66	40	12.5	6.5	7.5	9.5	8	19
4397	" "	"	122	64	38.5	13	7	7	9	9	19
4384	" "	"	116	64	43	13.5	7	7	8	8.3	20
4394	" "	"	113	64	41	13	6.5	7	9	8.3	19
4378	" "	"	122	64	39	13	7	8	10	8.5	17.5
4365	" "	"	—	61	41	13	5.3	6.5	9	8.7	19.7
4391	" "	"	112	65	37.5	13.5	7.5	7.5	8.5	9	20.5
4377	" "	"	122	62	40	13.5	6.7	7	9.7	8.5	18
4399	" "	"	112	62	39	13	6.3	6.7	8.5	9	19.3
4368	" "	"	118	64.5	39	12	6.5	7	9	7.5	18
4408	" "	"	120	63.5	38	12.5	6.5	7	9.5	8.5	19
3926	" "	♀	114	63	40	12.5	6.5	6.3	8.3	8	18.7
3913	" "	"	114	60	42	13	7	6.7	9	8.5	19
4162	" "	"	110	59.5	47	12	6	6.7	8.5	7.5	18.5
4193	" "	"	112	61	45	13	6.3	6.5	8.7	8	19.5
4261	" "	"	115	61	44	12.5	7	6.5	9.7	8	18.5
4286	" "	"	125	62	39	13.5	6.5	6.7	8.3	8.3	19
4779	" "	"	118	61.5	35	12.5	6.5	6.5	8	7.5	19
4398	" "	"	108	69	39	12	6.5	6.5	8	9	17
4383	" "	"	112	59	34	12.5	6.5	7	8	8	19.5
4343	" "	"	112	59	36.5	13	6.3	6.5	8.7	8	19
4359	" "	"	110	61	38.5	13	6	6.5	8.5	8	19.5
4395	" "	"	112	62	44	13	6.7	7	8.7	8	19.5
4364	" "	"	112	61	42	12.5	7	6.5	8	8.5	19
4349	" "	"	—	61	37	11.5	6	6	8	7.7	20
4392	" "	"	110	59	39	11.5	6	6.5	8	8	19
4401	" "	"	111	59	35	12	6.5	7	8.5	8	18
4406	" "	"	115	62	40	11.5	6.5	7	8.5	8	17.5
4402	" "	"	123	62	38	13	6.5	6.7	8.5	8	19
4367	" "	"	115	60	39	12	6.5	6.5	7.7	8	18
4369	" "	"	115	61	38	12	6.5	6.5	8.5	8	18

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa parvula.—Continued.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4376	Albemarle, Tagus Cove.	♀	115	60	38	13	6.3	6.5	8.5	8	18.5
4388	" "	"	112	58.5	36.5	13.5	6.5	6	8.5	8	18
4409	" "	"	122	62	44	13	6.5	6.7	8.7	8.3	18.5
4250	" Elizabeth Bay.	♂	113	62	40	13.3	6.7	6.7	9	8.3	19.5
4243	" "	"	109	64	40	12.5	6.3	6.5	8.5	8	19
4297	" "	"	128	64	41	13.5	6.5	7	9	8.5	19.7
4300	" "	"	122	62	44	13	6	6.5	9.5	8	18
4217	" "	"	116	65	42.5	12.5	6.5	7	8.5	8	19
4263	" "	"	118	63	39	12		6.5	8	7.5	18.5
4287	" "	"	111	62	39.5	12	6	7	8.5	7.5	18
4209	" "	"	114	63	37.5	12.5	6	6.5	8	8	18.5
4293	" "	"	133	62	40	12.5	6.5	6.7	9	8	19
4357	" "	"	118	65.5	40	12.3	6	7	9	8	19
4323	" "	"	117	64	40	13	6.5	7	8.5	8.5	20
4336	" "	"	115	63	42.5	12	6.3	6.5	8.5	8	19
4303	" "	♀	120	62.5	38	12	6	6.5	8.5	7.3	18.3
4265	" "	"	108	59	35	13	6.5	7	7.5	8.3	18.5
4232	" "	"	110	60	37	12.5	6	6	8	7	19
4285	" "	"	118	62	40	12.5	6.5	6.7	8.7	8	19
4301	" "	"	111	60	44	12	6	6.3	8.3	8	18.3
3938	" Iguana Cove.	♂	120	63.5	40	13	7	7	8.5	8.3	18
4095	" "	"	110	62	38	13	7	7	9	8.5	19.7
4066	" "	"	107	66	45	13.5	6.5	7	8.3	8	21
4084	" "	"	115	64	43	12.7	6.3	7	8.5	8.7	20
4060	" "	"	119	63	39.5	12.3	6.3	6.7	8.5	8	20
4019	" "	"	116	64	44.3	13	6.7	6.7	8.5	9	19
4325	" "	"	123	64	39	12.7	7	6.7	8.5	8.5	18
4338	" "	"	126	63.5	41	12.3	6.5	6	8	8	19
4307	" "	"	115	63	37	13	7.5	7	8.5	8.5	19
3950	" "	♀		67	41	12.3	6.5	7	9.5	8.3	19
4059	" "	"	119	63	41	13	6.7	6.5	8.7	8	19
4056	" "	"	117	60	43	12.5	6.5	7	8.5	8	18
4051	" "	"	107	60	40	13	6.7	6	8	8	20.5
4078	" "	"	114	60	38	12.5	6.7	6	8.7	8	18.5
4063	" "	"	110	62	39.5	13	6.3	7	9	8	19
4057	" "	"	107	60	40	12.3	6.3	6.7	8.5	8	19
4300	" "	"	115	61	34.5	12.5	6.5	6.5	8.5	8.5	20
4330	" "	"	115	57.5	37.5	12.5	6.5	6.5	8.3	8.5	18.5
4009	Narboro.	♂	111	62.5	37.5	12	6.7	7	8.5	8	18
4151	"	"	113	62	42.5	12	6.5	6	8	8	18
4159	"	"	119	62	44	13	6	6.7	8.9	7.7	19
4119	"	"	105	62	40	12.7	6.5	6.5	8.3	8	20
4164	"	"	112	64	40	13	6	6.5	8	8	20
4465	"	"	121	65	36.5	12.7	7	7	8.5	8.5	18.5
4413	"	"	120	62	40	13	6.5	7	7.5	9	18
4460	"	"	122	62	39.5	12	7	7.5	9	8.5	19
4431	"	"	113	65	38.5	14	8.5	7.3	8	9.5	19.3
4449	"	"	128	64	40	14	8.3	6.5	8	9.5	20
4426	"	"	118	63	38	12	6	6.3	6.5	8.3	18.5
4004	"	♀	118	62	42	12.5	6	7	9	8	18.5

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa parvula*.—*Continued.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
3885	Narboro.	♀	115	63	41	13	6.7	6.3	8.7	8	19
3988	"	"	118	64	42.5	11	6	6	8.3	7.7	18.5
4440	"	"	112	61	37	13	7	7	7.5	8.5	17.5
4448	"	"	122	64	37	12.3	6.5	7	7	8.5	18.5
4618	South Seymour.	♂	119	63	36	14.3	6.5	6.7	8.7	9	19
4633	" "	"	124	60	39	13.3	7	7	8.5	8.3	19
4645	" "	"	123	65	39.5	13	7	7	8.5	8	19
4678	" "	"	126	65	38	13.5	7	7	9.5	9	18.5
4652	" "	"	124	60.5	38.5	13	6.5	7	7	8	19
4630	" "	"	123	64	39	13.7	7	6.5	8.7	8.7	19.5
4662	" "	"	120	61	40	13.5	6.5	6.5	8.5	8.5	18.5
4639	" "	"	115	63	36.6	12.5	6.5	7	8.5	8	18
4617	" "	"	125	60	39	13	6.3	6.7	9	8.5	19
4677	" "	"	123	62.5	39	13.5		7	8.5	7.5	16
4631	" "	"	117	63	37	12.5	6	7	8.5	8	19
4688	" "	"	123	63	38	13	6.5	6.5	8.7	8.7	20
4699	" "	"	120	64	38	13.5	7	7	9	8.7	19
4636	" "	"	120	62	37	14.3	6.5	7	9.5	8.7	18
4676	" "	"	125	64	38	12.5	6.5	6.7	8.3	8.3	18
4610	" "	"	120	63	36	13.3	6.3	6.5	8.5	8	19
4641	" "	♀	133	60	30	13.7	7	6.7	8.5	8.7	18
4673	" "	"	113	60	38	12	6.5	6.3	8	8.5	17
3899	" "	"	120	60	37.5	13	6.5	6.5	9	8.5	18.5
4611	" "	"	106	59	36	14	7.5	7	8.5	9	18
4697	" "	"	118	59	34.5	13	6.5	6.5	8.5	8.5	18
4657	" "	"	111	60	39	13.3	6.5	7	8.5	8.5	19.5
4651	" "	"	116	58.5	33	13	7	6.7	8	8.5	18
4964	Barrington.	♂	120	60	35	14	7	7	8.7	9	20
4971	"	"	123	63	39.5	13	6.7	6.7	8.5	8.5	18
4970	"	"	119	62	38.5	13	7.5	6.5	8	8.5	18.5
4948	"	"	123	61	37.5	13	6.7	7	9	8.7	18.7
4940	"	"	117	60	38	13	7	6.7	8.5	8.5	18
4944	"	"	113	61.5	37	13	6.5	7	8.7	8	18.5
4946	"	♀	116	59	35	13.7	6.5	6.5	8.3	8.3	19
4937	"	"	116	59.5	37.5	13	6.3	6	7.5	8.5	17.3
4936	"	"	115	58.5	34	12.5	6	6.5	8.5	8	17.5
4698	Indefatigable.	♂	—	60	38	12.7	6	6.5	8.5	8	18
4661	"	"	112	63	38	13	6	6.5	8.5	8.5	19
4663	"	"	116	62	39	13	6.7	6.7	8.5	8.3	19
4706	"	"	120	63	41	12.5	6.3	6.3	8.3	8	19
4671	"	"	120	62	41	13	6.5	6.7	8.5	8	19
4674	"	"	120	62	38.5	12.3	6.3	6.5	8	8	19
4534	James.	"	116	64	44	13.3	7	6.5	8.5	8.5	20
4556	"	♀	112	58	37	12.3	6.3	6.3	7.3	8	19
4507	"	"	116	62	42	14	6.5	6.5	8	9	19.5
4737	Charles.	♂	122	64	38	13.7	7	6.7	8.5	9	20
4881	"	"	—	62	38	12.5	6.5	6.5	8.5	8	18.5
4710	"	♀	120	60	38	12.5	6.5	6.5	8.5	8	18
4731	"	"	110	61	36	12.5	6.7	6.5	8	8.3	19
4885	"	"	120	59	35	13	6.6	6.5	8	8.3	19

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa parvula*.—*Continued.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4855	Charles.	♀	122	60	42	13.3	7	6.5	8.5	9	18
4866	"	"	120	62	38	12	7	6.5	8.7	8	18
4744	Hood.	♂	120	63	36	13.5	7	7	10	9	18
4716	"	"	—	61	40	13	6.5	6.5	8.5	8.5	18.5
4850	"	"	120	62	39	13.5	7.3	6.5	9	8.5	18.5
4624	Duncan.	"	115	58	35	13	6.5	6.7	9.5	8.3	18
4608	"	"	120	64	39.5	13.3	7	7	9.5	9	19
4714	"	"	117	61.5	36	13	6.3	7	9	8	18
4614	"	♀	116	61	35	12.5	7	6.5	9	8.3	19
4622	"	"	118	56	40	13	7	6.5	8	8.7	18
4730	"	"	123	59	36	13	7	6.3	8	8.5	18

dom included in the nest material. There is no special lining. Some nests have a somewhat finer material on the floor than elsewhere, but the floor is generally more compactly and more solidly formed than the other parts. Three of the nests from Tagus Cove contained eggs — two sets of four each and one set of three. The eggs of set No. 1 have the usual pale greenish-white ground color of all the *Geospiza* eggs, spotted and heavily blotched about the larger end with brownish, vinaceous and rusty-brown, and sparingly spotted with brownish over the rest of the surface. Measurements: 19.5 × 14.5; 19.5 × 14, 19.5 × 14.5; 19 × 14.5. Set No. 2 has the same ground color as the first, but is finely and nearly uniformly spotted with vinaceous so thickly as nearly to obscure the ground color; one of the specimens, however, is spotted only about the large end. Measurements: 19 × 14; 19.5 × 14; 18 × 13.5; 18 × 13.5. Set No. 3, of three eggs, is like the firs tin coloration. Measurements of two specimens: 18.5 × 14.5; 18.5 × 14. These *Geospiza* eggs greatly resemble the eggs of *Spizilla pusilla* but are much larger. Some light-colored eggs of *Junco hyemalis thurberi* are very much like them in coloration.

Several nests and two sets of three eggs were collected at Iguana Cove in the latter part of December. The eggs are like those from Tagus Cove in size and are similar in coloration. One set has a paler ground color and is considerably more spotted with rusty-brown. The nests do not differ from those taken at Tagus Cove.

One set of three eggs was taken at Elizabeth Bay, Albemarle, in February. The eggs of this set are somewhat larger and more ovoid in shape than any of the specimens taken either at Tagus Cove or Iguana Cove. Measurements: 19.5 × 15; 18.5 × 15; 19 × 15.

The following pairs were taken mated: Nos. 4662–4673, 4633–4657, 4187–4182, 4341–4349, 4400–4359, 4377–4402, 4394–4364, 4403–4401, 4391–4395, 4368–4392, 4408–4409, 4378–4406, 4384–4369, 4389–4367, 4397–4388, 4366–4376, 4325–4308, 4307–4330, 3938–3950.

62*b*. GEOSPIZA FULIGINOSA FULIGINOSA Gould.

Geospiza fuliginosa GOULD, Proc. Zool. Soc., p. 5, 1837 (Chatham).
Geospiza parvula RIDGWAY (not of GOULD), Proc. U. S. Nat. Mus., XIX, p. 529, 1896.
Geospiza fuliginosa fuliginosa ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 161, 1899.

Range. — Chatham Island.

In the collection from Chatham Island there are twelve specimens of this species. As a series these differ considerably from the *G. fuliginosa* of other authors from James, Albemarle, Narboro, Indefatigable, Duncan, Charles, Barrington and Hood. The bill is longer and more slender with the basal depth about the same and the wing averaging slightly larger. Two of the specimens are scarcely distinguishable in shape and size of bill from *G. f. acutirostris*. This form approaches closely in size of bill to *G. dentirostris* but the wing is considerably less than sixty-eight millimeters.

This species was found abundantly on Chatham in May and generally distributed. The song consists of two notes, *zēē' ŭrr*, repeated twice.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa fuliginosa*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4717	Chatham.	♂	127	64	41	13.5	7	6.7	9	8.7	18.5
4829	"	"	126	65	39	14	7	6.5	8.5	8.5	19.5
4821	"	"	120	64	41	14	7	7	9	9	19.7
4856	"	"	128	65	42.5	14.5	8	7	9.7	9.7	20
4714	"	♀	116	59	36	12.3	6.5	6	7.5	7.5	17.5
4786	"	"	117	62	36	12.5	6.5	6.5	8.5	8	17
4715	"	"	122	60	36	14	7.5	6.5	8.7	9	19.5
4895	"	"	120	63	37	14.5	7.5	7	8.5	10	19
4749	"	"	120	60	—	13	7.3	6.5	9	9	19

62*c*. GEOSPIZA FULIGINOSA MINOR Rothschild and Hartert.

Geospiza fuliginosa minor ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 162, 1899.

Geospiza fuliginosa SALVIN, Trans. Zool. Soc., IX, p. 483, 1876 (part). — SHARPE, Cat. Birds Brit. Mus., XII, p. 13, 1888. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, pp. 526, 529, 1896 (part).

Range. — Abingdon and Bindloe.

Similar to *G. f. parvula*, but averaging smaller, wing usually less than sixty millimeters, culmen about twelve and one half.

This variety is common on both Abingdon and Bindloe. It occurs everywhere on Bindloe which is comparatively low, but on Abingdon it was found only below eight hundred feet altitude, Abingdon reaching an elevation of nineteen hundred feet.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa minor*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5254	Abingdon.	♂	102	55.5	34	12.7	7	7	8.5	8.5	18
5195	"	"	114	58	30.5	12.3	6	6	7.5	7.5	18
5158	"	"	110	58	36	13	6.7	6.5	8	8	18.3
5117	Bindloe.	"	115	56.5	36	12	6.5	—	7	8	18
5128	"	"	117	55	35	12.5	7	6	7	8.7	18
5165	"	"	111	58.5	35	12.5	6.3	6.3	7.5	8	18

62*d*. GEOSPIZA FULIGINOSA ACUTIROSTRIS (Ridgway).

Geospiza acutirostris RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 363, 1894, and XIX, p. 531, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 506, 1901. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 162, 1899.

Range. — Tower Island.

Very similar to *G. f. fuliginosa*, but bill more acute, with straighter outlines; the culmen averaging fourteen and one half millimeters and the basal depth eight and one half millimeters. Our birds, which were taken in June, all have pinkish-horn-colored bills, but are apparently adult.

This is the most common *Geospiza* on Tower, where it occurs abundantly near the coast, frequenting the cactus (*Opuntia*) thickets.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa acutirostris.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5292	Tower.	♂	118	61	39	14	7.5	6.5	8.5	9.3	18
5189	"	"	115	63	42	13	7	6.3	8.7	9	18
5169	"	"	115	62	40	14.5	7.3	7	8.5	9.3	17.5
5157	"	"	120	61.5	38	15	8	6.5	8	10	17
5291	"	"	123	66	43	15	8	6.5	8	9.7	19.5
5182	"	"	121	63.5	41	15	8.5	7	9	10	19
5176	"	"	111	59.5	40	14	7	7	8.3	8.7	18
5133	"	♀	110	59	38	13	7.3	6	8	9	17.5
5265	"	"	115	60	40	14	7.7	6.5	8.5	9.3	17

62*e*. GEOSPIZA FULIGINOSA DIFFICILIS (Sharpe).

Geospiza difficilis SHARPE, Cat. Birds Brit. Mus., XII, p. 12, 1888.—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 532, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 507, 1901.—ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 163, 1899.

Range. — Abingdon Island.

This form is very close to *G. f. acutirostris* of Tower, from which it differs in the slightly larger bill. Some of our specimens, however, are quite indistinguishable from specimens of *G. f. acutirostris* and we have, hence, united this form with the *fuliginosa* group. This gives *two subspecies* of *G. fuliginosa* to Abingdon, but *G. f. difficilis* is quite distinct from *G. f. minor.* This latter species, also, as before stated, inhabits only the lower parts of the island, ranging from sea level up to about eight hundred feet. *G. f. difficilis*, on the other hand, appears to be restricted to the higher parts of the island, where it is common. It was the only form seen above fifteen hundred feet, and it was here most abundant, while below five hundred feet it was not met with at all.

This is one of the few forms that occur on Abingdon but not on Bindloe. Perhaps the lesser height of the latter island, which does not reach an altitude greater than eight hundred feet, accounts for the restriction of this species to Abingdon.

We must now make a break in the series which leads on uninterruptedly from the form last described through *G. debilirostris* and *G. septentrionalis* to the forms comprising the next and highest subgenus, *Cactornis.* We do this in order to go back again to *G. fuliginosa parvula* and insert another series which begins with *G. fortis* and leads up to the largest billed forms of *Geospiza*, viz., *G. strenua* and *G. magnirostris*, but which in plumage are more generalized than the members of the *Cactornis* group. It was only for the conventionality of placing all the varieties of a species in continuous succession that we did not insert the *G. fortis magnirostris* series immediately after *G. fuliginosa parvula*.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fuliginosa difficilis*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5216	Abingdon.	♂	128	61	36	15.3	7.7	7	9	9.5	20.5
5279	"	"	118	63	33.5	14.7	8	7	9	9.7	20
5254	"	"	130	62	39	15.5	—	6.5	8	10	20
5192	"	"	120	59	35	15.5	8	7.5	9	9.7	19.5

63. THE GEOSPIZA FORTIS SERIES.

Under this series we include forms that have by Ridgway and Rothschild been kept separate in two groups, *G. fortis* and *G. dubia*. We have specimens from the southern end of Albemarle at Iguana Cove that absolutely bridge over the differences between the previously known forms of these two supposed species. These Iguana Cove specimens we have described as a new subspecies, *G. fortis platyrhyncha*. This grouping of all the forms heretofore separated into the species *fortis* and *dubia* leads us into the necessity of recognizing two subspecies of the same species on the same island wherever the two forms occur. There are four cases of this sort: *G. f. fortis* and *G. f. dubia* occur together on both Chatham and Duncan; *G. f. fortis* and *G. f. bauri* occur on James; *G. f. fortis* and *G. f. simillima* occur on Charles. *G. f. simillima* Rothschild and Hartert is a variety of very doubtful standing, but the other three cases are apparently well substantiated. On these islands when two subspecies of *G. fortis* occur together in this manner, the two forms are always entirely distinct, and intergrade as subspecies only through individuals on some other island. On Albemarle where two subspecies occur they are geographically separated and intergrade on the intermediate territory just as do subspecies inhabiting contiguous areas on the mainland. It may of course be questioned whether groups of individuals living on different islands and showing some average difference as groups, but yet intergrading in their variations, should not be regarded as true species, since these intergradations are evidently due to overlaps in individual variation and not to interbreeding, on account of their isolation on the different islands. This is a point that we do not attempt to discuss, and simply follow the conventional canons of the A. O. U. nomenclature.

Geospiza fortis as a species, including all the *fortis* varieties, has its bill variation confined within the following limits in mature birds: Length of culmen, 15 to 20; depth of bill at base, 11 to 16; width of bill at base, 8 to 12. In both length of the culmen and width of the bill at the base it intergrades with *G. fuliginosa*, but there is a constant difference in the depth of the bill, the greatest basal depth in *G. fuliginosa* being 9.5.

Subspecies at the lower end of the *G. fortis* series have the bill shaped exactly like that of *G. fuliginosa parvula;* those at the upper end have bills of a proportionally greater depth and with a rounded culmen.

63*a*. GEOSPIZA FORTIS FORTIS (Gould).

Geospiza fortis GOULD, Proc. Zool. Soc. Lond., p. 5, 1837. — Zool. Voy. Beagle, III, Birds, p. 101, pl. 38 (Charles Island). — SALVIN, Trans. Zool. Soc. Lond., IX, p. 481, pl. 9, 1876. — SHARPE, Cat. Birds Brit. Mus., XII, p. 10 (in part). — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 521, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 502, 1901.

Geospiza nebulosa GOULD, Proc. Zool. Soc. Lond., p. 5, 1837. — SHARPE, Cat. Birds Brit. Mus., XII, p. 11 (in part).

Geospiza albemarlei RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 362, 1894; Bull. U. S. Nat. Mus., 50 Pt. I, p. 502, 1901.

Geospiza dubia albemarlei ROTHSCHILD AND HARTERT, Nov. Zool., VI, p. 160, 1899.

Geospiza fortis fortis ROTHSCHILD AND HARTERT, Nov. Zool., VI, p. 161, 1899.

Range. — Charles, Gardner (near Charles), Chatham, Indefatigable, Seymour, Duncan, Jervis, James, Albemarle (Tagus Cove) and Narboro.

This form presents the least departure from *Geospiza fuliginosa fuliginosa*. In shape and size of the bill it is intermediate between *G. f. fuliginosa* and *G. f. dubia* of the upper end of the *G. fortis* series. Adults of *G. fortis fortis* and *G. fuliginosa* are always distinguishable by the larger bill of the former, but young birds of *G. fortis* have bills almost exactly duplicating those of adults of *G. fuliginosa*. We have examined young specimens which in fact could not be definitely assigned to either species.

Ridgway has described specimens from Albemarle as *Geospiza albemarlei*. His specimens probably came from either Tagus Cove or the southeast part of Albemarle, for these are the only localities that collectors up to that time had visited. Specimens from Tagus Cove do not differ from specimens of *G. fortis fortis* of the other islands. Some of those from southeast Albemarle have rather longer and deeper bills, but they grade into *G. fortis platyrhyncha* of Iguana Cove at the southwest end of Albemarle. Hence there are two varieties on Albemarle, but these are *G. f. fortis* and *G. f. platycephala*. If the *type* of *G. albemarlei* had come from Iguana Cove, then this name could be retained.

Our specimens of this species are from Charles, Chatham, James, Indefatigable, Seymour, Albemarle and Narboro. The species was found most abundant on Charles, James, Albemarle and Narboro.

We have twenty two specimens of adult males taken at Tagus Cove in January, February and March. They are in Stages III to VI. There are two in Stage III, taken in March; two in Stage IV, taken in January and one taken in March; four in Stage V, taken in March and one taken in January; and six in Stage VI, taken in January, one taken in February and four taken in March.

Adult Males. — Coloration almost exactly the same as in *Geospiza fuliginosa parvula*. Deep black everywhere except on the wings and tail, which have a brownish tone.* Under tail coverts bordered with white. In some there is a varying amount of grayish color on the posterior part of the belly and on the flanks as pale edgings to the feathers; in such cases the entire exposed parts of the under tail coverts are gray. This pale color generally lacks the buffy tinge present in *G. fuliginosa*. Bill black. Feet brown.

The same plumage stages are distinguishable as in *G. fuliginosa*, but all the specimens except one, even down to those in Stage III, have the bill entirely black. One specimen intermediate between Stages V and VI, however, has the lower mandible yellow with black only on the sides of the base and at the base of the gonys. There is in no stage any buffy tinge to the pale parts of the plumage, a mark distinguishing the species from *G. fuliginosa*. There are only three young males in the collection taken in January; two of these are in Stage IV, one has yellow on the lower mandible; the other is in Stage V. March birds are in Stages III to VI. The yellow-billed January bird has a few new feathers coming in on the back and breast; the other January specimens are not moulting. None of the March birds are moulting.

The males of this species apparently are longer in acquiring the black plumage than are the males of *G. fuliginosa*. The bill becomes black by the beginning of the breeding season, but the plumage does not. The species nests at Tagus Cove in March. Several pairs of mated birds were secured at this time, and many others observed, of which the males were in immature plumage, some scarcely distinguishable from the females. In fact, the number of mated black billed males in immature plumage nearly equalled the number of mated males in black plumage.

Adult Females. — We have three adult females taken in January, one taken in February and three taken in March. The bills are not as dark as in the males. The upper mandible is dusky or brownish-black, while the lower is generally still paler. One of these females is moulting; it is a March bird with entirely dark bill and was taken mated with an adult male.

Immature Females. — There are eight immature females in the collection, all taken in January. They have yellow or partly yellow bills. The plumage in some is the same as that of the adult females, but it varies from this to much paler, where the brown is not nearly so conspicuous. Since no yellow-billed specimens were taken in March, it appears that they acquire the dusky bill before this month, probably in February. Nearly all of the young females are moulting, but the new feathers are most numerous and conspicuous in the paler plumaged birds. The absolute amount of brown color on the feathers of the adult females and the darker immature ones is much greater than on the feathers of the paler younger birds, so that the moult must be accompanied by a change in the color of the feathers.

Specimens from Narboro do not differ in the form of the bill from those taken at Tagus Cove on Albemarle. The collection contains four adult males in black plumage with black bills, taken in April on the east side of the island. There are four males in black plumage, taken in January on the north side of the island, that present the following very unusual coloration of the bill for birds in black plumage in January: the upper mandible in all four is brownish-horn, in two the lower mandible is light horn-yellow with dusky tip; in the other two the lower mandible is mostly the color of the upper, but is yellow at the base. These birds must either have been very late in acquiring the black bills, or else precocious in attaining the black plumage. One of these black, yellow-billed birds is moulting.

There are seven specimens taken on Seymour and the adjoining part of Indefatigable, during the last of April and the first of May. One specimen is an adult male in purely black plumage and with a black bill. Two are brown-backed males with much pale color on the edges of the feathers of the belly. The occurrence of these forms after the breeding season would indicate that the purely black plumage is not acquired until during the second year. Another specimen is a male in Stage V, and another a male in Stage IV. Both of these have black bills and are moulting. There is one adult female with a black bill, and finally one young bird in Stage II with a yellow bill. These specimens indicate the same thing concerning the acquisition of black as do the specimens from Tagus Cove, Albemarle, viz., that the bills of the males are nearly always black by the breeding season, but that the plumage may be only in Stages V or IV.

We have twenty specimens of *Geospiza fortis* from James Island, taken in April about James Bay. All of them apparently belong to the subspecies *G. f. fortis*, being the same as those at Tagus Cove. We have no specimens from James that we could identify as *G. f. bauri*. Nine of the specimens are adult males, all having black bills, but some are in the black phase of Stage VI and others in the brownish. Several in each phase are moulting. One male in Stage V and two in Stage IV are each moulting slightly, all having black bills. Three are adult females, one with a black bill, two with the bill dusky above and paler brownish beneath. Five are young birds but recently from the nest, all in Stage II with yellow bills and soft plumage, and all are moulting.

From Charles there are in the collection twelve specimens taken in May. Eleven of them clearly belong to the subspecies *G. f. fortis*. One, however, an immature male with the lower mandible yellow, has a bill much larger than that of the others and resembling the bill of *G. fortis dubia* of Chatham. This specimen may perhaps be *G. fortis simillima* (Rothschild and Hartert). Five of the Charles specimens are adult males; two are immature males in Stage IV; four are adult females; and one is an immature female, having the lower mandible yellow and a few new feathers growing in.

Habits, Song, Nests and Eggs. — At Tagus Cove, Albemarle, *Geospiza fortis fortis* was found fairly abundant, associating with *G. fuliginosa parvula*, but was always much less numerous than this species. The songs of the two were different but not radically so, being often very similar, and were always constructed on the same plan. One song consisted of two syllables of which the first had an *ê*-sound (thêre) and was much prolonged by a sort of *r*-like trill, while the second had a long *e* sound and carried the accent. The song may be represented thus: *têr-r-r-r-wee'*, *têr-r-r-r-wee'*. The birds were singing but little at this time, and were very scarce in the mangrove swamps about Turtle Point.

During March the birds at Tagus Cove were nesting and the males were singing much more than in January. A common song at this time resembled *teur'-wee-wee*, *teur'-wee-wee*, *teur'-wee-wee*. The accent was always conspicuously placed on the first syllable in each set. Often all these notes resembled the first, or this was only slightly different from the other two. In this case the song much resembled that of the Elizabeth Bay *Geospiza heliobates*. This song, having all the notes nearly alike, was connected by numerous intermediate varieties with the other. They sang also a bisyllabic song resembling *twĕr-twĕr*, *twĕr-twĕr*. This was much like the song of the *Geospiza heliobates* of the Narboro and Turtle Point swamps. The vowel sound, however, differed noticeably in the two, that of the former lacking the pure *ĕr* sound of the latter.

About the middle of March *Geospiza fortis fortis* was found rather numerous in the mangrove swamp north of Tagus hill. They were continually singing a song sounding like *tee'-wĕr-wĕr*, *tee'-wĕr-wĕr*, *tee'-wĕr-wĕr*. Nearly always three sets were uttered in succession. We shot a male that was uttering the sound almost continually, and flying all the time from tree to tree ranging back and forth over a considerable area. Others were heard doing the same. They varied the vowel sound of the syllables so much that often the first had the sound of the second and third and these two the sound of the first, thus: *tür-wee-wee*. Sometimes, especially when the bird observed was at a considerable distance, all three syllables had the *ĕ* or *ü* sound, and then the song much resembled the song of the *G. heliobates* at Elizabeth Bay. In such cases, however, the initial consonant sound of the first syllable is generally different from that of the second and third syllables, thus: *tür'-wür-wür*, *tür'-wür-wür*, *tür'-wür-wür*.

During March a mated pair of these birds selected an acacia bush in the small canyon at the head of Tagus Cove as their home for that season. The male constructed the nest, the female taking no part in the actual labor; but she frequently came about while the nest was being built, apparently to inspect and approve or disapprove of the work of her partner. The latter never worked hard at the nest but spent most of his time flying excitedly about and singing, working only occasionally. Whenever the female came to the nest he quit work entirely to remain near her and to fly about with her. This pair was observed for a number of days and at all times during the morning. The male whenever heard sang the same thing, a song which may be represented as follows: *zee''u-twee''u*. The difference between the initial consonants of the two parts was very marked and scarcely

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fortis fortis.*

Cat. No. Stan Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4201	Albemarle, Tagus Cove.	♂	137	73	49	17	8.5	9.5	13	11.5	21
4006	" " "	"	138	75	49	18.5	10	9.7	14	12	21
3980	" " "	"	125	68	48	17.5	9	9.7	12.5	12	20.5
3978	" " "	"	132	70	42	16.5	8.5	9.5	13	11	20.5
4132	" " "	"	131	71	49	17	8.5	10	13.5	11.5	21
4294	" " "	"	135	72	42.5	18	9.5	10.3	14.5	12	23
4322	" " "	"	142	74	44	17	9	9.5	13.3	12	22
4208	" " "	"	140	75	44	18	9.5	10.3	13.5	12.5	22.5
4039	" " "	"	115	71	41	17.7	9.7	9.7	13	12	22
4393	" " "	"	118	70	39	16.5	—	9	12	11	21.5
4371	" " "	"	127	70	43	17.5	9	9.5	12	12	21.5
4176	" " "	"	117	66	39	16	8	8.3	11	10.5	20
4407	" " "	♀	138	71	42	18.5	9.5	11	14	13	21
4133	" " "	"	128	66	39	15.7	8.5	8.5	11.5	10.5	20
4142	" " "	"	127	68.5	44	17	8.3	9	14	11	22
4181	" " "	"	118	67	38.5	16.7	8.5	8.7	12	11.5	20.7
3958	" " "	"	125	70	42	19	10	11	14	12.3	23
4028	" " "	"	128	72	49	18.5	9	10	13	12.5	20.5
4147	" " "	"	127	68	49	17	8.7	9.3	12.3	11.7	21.5
4390	" " "	"	131	65	40	16	8.5	9	12	11	20
4387	" " "	"	120	64	34	16	8	9	11	11	21
4370	" " "	"	118	65	38.5	16.5	8.5	8.5	11.3	11	20
4264	" " "	"	120	66	40	15	8.5	8.3	11.5	10	19.5
4463	Narboro.	♂	136	70.5	41.5	16.5	8.5	10	12.5	12	19.7
4419	"	"	133	71	42.5	16.5	9	10	13	11.5	20.5
4459	"	"	140	72.5	44	17	10	9.7	13	12	21
4440	"	"	122	66	38	16.5	9	9.5	12	11.5	21.3
3933	"	"	131	70	42	16.7	9	9.7	12.5	11	20
3971	"	"	130	72	43	16.7	8.5	9.3	12	11.3	21
4006	"	"	130	73	42	17	8.5	9.5	12.5	11.5	21
3952	"	"	133	70	44	17	9	9.5	11.7	11.3	20.5
4464	"	"	139	69	38	17	9.5	10.3	13.5	12	18.5
4870	Charles.	"	135	68.5	43	16.5	9	9.3	13	11	20
4833	"	"	130	69	41.5	16	8	8.5	11	10.5	19
4722	"	"	140	73	43	16.7	8.7	9.5	12	11	21.5
4717	"	"	134	70	40	17	8.5	9.7	12	11	20.5
4892	"	♀	136	70	43	17	8.5	9.5	13	11	21
4725	"	"	128	67	40	16	8	8.7	11.5	10.5	19
4723	"	"	130	66	40	16	8.3	8.5	11.5	10.5	20.5
4878	"	"	—	68	43	17.7	9.3	9.7	13	12	19.5
4867	"	"	139	73	42	18	9.7	9.5	13.3	12	20
4702	Indefatigable.	♂	130	70	43	17	9	9	12.5	11	20.5
4707	"	"	131	69	35	17.5	9	10	12.7	12.5	21.5
4667	"	"	132	68	41.5	17	8.7	8.7	12.3	11.5	20
4644	South Seymour.	♀	135	68	39	17	9	9.5	12	11.3	20.5
4601	James.	♂	128	70	40	17	9	10	13	11	21.5
4535	"	"	135	72	44	18	9.3	10	13.3	11.5	21
4476	"	"	124	70	42	17.5	9	10	13	11.5	21.5
4510	"	"	128	74	44	17	8.5	9.5	12.3	11	22
4501	"	"	134	71	44	16	8.3	9	12.5	10.7	21

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fortis fortis*.—*Continued.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4458	James.	♂	122	73	44	18.5	10	10	14	12.5	20.5
4506	"	"	123	71.5	50	16	8	8.3	11	10	20
4504	"	"	133	70.5	46	18	9	10	12.5	11	21
4503	"	♀	123	67	41	16	8.5	8.7	11	11	20.3
4515	"	"	120	68	45	17	9	9	12.3	11.3	20
4555	"	"	133	67	45	16.5	8.3	9.5	12.5	10.7	22

ever did the bird make any variation. Another male bird of the same species was observed flying about in the neighborhood of a tree in which was a large *Geospiza* nest with eggs uttering continually these same notes. No female, however, was ever to be seen about or in the nest and the eggs were always cold so she had probably been killed, yet the male remained in the neighborhood singing as if the female were still on the nest.

During March a bird at Tagus Cove was heard singing *tee'up-twee'u*.

At Iguana Cove in December one bird was observed singing a song resembling *twee'-ur'r'r*, *twee'-ur'r'r*. This was uttered generally twice in succession, often only once, sometimes three times. (The representatives of the species at Iguana Cove belong to the subspecies *G. f. platyrhyncha*.)

On James Island about James Bay the relative numbers of *Geospiza fuliginosa parvula* and *G. fortis fortis* were just the reverse of what they were at Tagus Cove, Albemarle. Here on James the *G. fortis* was the commonest species of *Geospiza*. Their song very much resembled the common song of the individuals at Tagus Cove, sounding somewhat like *teu'-we*, *teu'-we*.

On Charles Island one song of *Geospiza fortis fortis* almost exactly resembled the song of *G. fuliginosa parvula* of Tagus Cove. The accent was always on the first syllable and may be represented thus: *teur'-wee*, *teur'-wee* — no difference was noticed that could be described by alphabetical sounds. The same birds, however, sang numerous different songs.

Two nests collected at Tagus Cove in March were placed in bushes, and are of the same shape as the nests of *G. fuliginosa* described. Both were composed almost wholly of grasses, but were very unequal in size. One was about the size of an ordinary *G. fuliginosa parvula* nest, the other was much larger, larger even than the nest of *G. strenua*.

In the smaller nest were four eggs. These do not differ, except in their larger size, from eggs of *G. fuliginosa parvula*. The ground color is pale greenish-white, finely spotted with brownish and vinaceous, the spots forming blotches about the larger end. They measure as follows: 21 × 16.5; 21 × 16; 21 × 16; 21 × 16.

The following pairs were taken mated: Nos. 4371–4390, 4361–4407, 4373–4387, 4503–4503.

63*b*. GEOSPIZA FORTIS FRATERCULA (Ridgway).

Geospiza fratercula RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 363, 1894, and XIX, p. 525, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 504, 1901.
Geospiza fortis fratercula ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 161, 1899.

Range. — Abingdon and Bindloe.

Our series of specimens of this subspecies from Abingdon and Bindloe show no difference in the shape or size of the bill from specimens of typical *G. f. fortis* from Charles. The wing, however, averages smaller and the body is smaller in proportion to the size of the bill than in *G. f. fortis* and these appear to be the only distinguishing characters of this form.

MEASUREMENTS OF *Geospiza fortis fratercula*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5203	Abingdon.	Ad. ♂	133	64	41	18	9	10.5	13	12	19
5073	"	"	133	65	40	16.5	9	9	11.5	11	19
5245	"	Im.	141	71	44.5	18	10	11	14	12.7	20.5
5222	"	"	121	63.5	40	16.5	8.7	9	11	11	18.5
5256	Bindloe.	Ad. ♂	128	67	38.5	18	9	9	12.5	12	18.5
5223	"	"	115	64	40	17	8.5	9.7	13	11.5	18.7
5184	"	"	120	65	37	17.5	9	9	12	11.5	20
5151	"	Im.	125	67	39.5	17.5	9	9.5	12	12	19
4724	"	Ad. ♀	122	60	37	16.7	8.3	9.3	12	12	18.5
5118	"	"	128	62	37	16	8.3	9.3	12	11	18.5

Found in June fairly common on Bindloe, but less abundant on Abingdon, where nearly all seen were young birds of the same year. There is no difference between the specimens from the two islands. The collection contains five adult males in either black or black and brownish plumage. Four have black feathers on the back with an admixture of brownish feathers, *i. e.*, the individual feathers are either purely black or brown. They are all moulting. Hence, it appears that here, at least, in June a moult occurs in which the brownish-black plumage is lost and the black acquired. We have one male in Stage V with the bill black, another with the bill black above and pale below, one in Stage III with the bill entirely pale. All of these are moulting. Two males in Stage IV, having the bills mostly pale but partly dusky above, are not moulting.

63*c*. GEOSPIZA FORTIS PLATYRHYNCHA
Heller and Snodgrass.

Geospiza fortis platyrhyncha HELLER AND SNODGRASS, The Condor, Vol. III, No. 3, May-June, p. 75, 1901 (Iguana Cove, Albemarle Island).
Geospiza platyrhyncha RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt. I, p. 673, 1901.

Range. — Iguana Cove, Albemarle.

This form is similar in size and proportions to *G. fortis dubia*, but the bill averages considerably wider at the base, being twelve millimeters or more in width. The variety intergrades through forms at the southeastern part of Albemarle and at Elizabeth Bay with *G. fortis fortis* at Tagus Cove.

It was not common at Iguana Cove either in January, March or June. We have three adult males taken in January and March in black plumage having very large thick bills with curved culmens, and two females, one adult taken in March, the other taken in December. The latter has the bill yellowish below and was moulting. The ovaries were enlarged, however, as if the bird was breeding.

Type. — Adult male, No. 5150 Leland Stanford Junior University Museum; Iguana Cove, Albemarle, Galapagos, June 7, 1899.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fortis platyrhyncha*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4355	Albemarle, Iguana Cove.	♂	151	77.5	46.5	19	10.5	12.5	16	13	22
4351	" "	"	148	76	44	18	9.5	12.5	15	13	23
5150	" "	"	147	75	46	18.5	9	12	16	13	22
4352	" "	♀	142	74.5	43.5	18.5	9.7	12	15	13	22
4048	" "	"		71	45	18	9.5	12	15.5	12.7	21.5

We have examined seven specimens of *Geospiza fortis* from the southeastern part of Albemarle at Villa Mil, in a collection belonging to Captain W. Johnson, of San Francisco, collected by Mr. G. M. Green, of San Francisco. The bills of these specimens vary from the *G. f. platyrhyncha* type to that of *G. f. fortis*. The following are measurements made on these specimens:

Locality.	Sex.	Wing.	Culmen.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.
Albemarle, Villa Mil.	♂	78	19	12	15	13
" "	"	71	16	10	12	12
" "	"	74	18	10	14	12
" "	"	73	19	12	15	13
" "	"	74	16	10	13	11
" "	♀	72	17	10.5	14	12
" "	"	72	18	10	14	13

There are in our collection seven specimens of *Geospiza fortis* from Elizabeth Bay, Albemarle. These resemble the Villa Mil specimens in presenting a great deal of variation. Some have bills as large as those of typical *G. f. platyrhyncha* specimens with strongly curved culmens; others are indistinguishable from ordinary *G. f. fortis* specimens. The following are measurements of the Elizabeth Bay specimens:

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4244	Albemarle, Elizabeth Bay.	♂	125	73	47	19	10	11	14.5	12.5	22
4346	" " "	"	137	74	48	17.5	10	11	15.5	13	21.5
	" " "	"	146	74	47	18.5	10	10.3	15.5	12.5	21.7
4290	" " "	"	130	68.5	38	17	9.5	10	13.5	12.5	21.5
4295	" " "	"	136	73	45	16.7	8.3	9	12.3	10.7	21.5
4298	" " "	"	136	69	42	16	8	8	11.5	10.7	21
4296	" " "	♀	140	72	41.5	17	9	9.5	12.5	11.5	21.5

These specimens undoubtedly bridge over the difference between the former species *G. fortis* and *G. dubia*.

63*d*. GEOSPIZA FORTIS DUBIA (Gould).

Geospiza dubia GOULD, Proc. Zool. Soc. Lond., v, p. 6, 1837. — RIDGWAY, Proc. U. S. Mat. Mus., XIX, p. 518, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 501, 1901.

Geospiza dubia dubia ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 160, 1899.

Range. — Chatham, Barrington and Duncan.

The bill of this form is shaped much like that of *Geospiza strenua*, being the longest of all the *G. fortis* bills except *G. f. bauri*, and has a strongly curved culmen.

All of the specimens of *G. fortis* that we obtained on Chatham belong to this variety, although *G. f. fortis* is recorded from Chatham by Rothschild and Hartert. We have four adult males, one adult female and two immature males taken in May. The immature males are in Stage IV; each is moulting slightly.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza fortis dubia*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
4790	Chatham.	♂	134	73	42.5	18.3	9.5	11	15	12.5	22
4894	"	"	138	77	46.5	19	10	11.5	15.5	13	22
4760	"	"	153	75	46	19	10	11.5	16.3	13	23.7
4851	"	"	150	76	48	18	10.3	10.7	14	12.5	22
	"	"	145	71	44.5	18.3	9.5	11.3	15	13	23
4712	"	♀	140	68	41	18	9.5	11	14	11.7	22.5

63*e*. GEOSPIZA FORTIS SIMILLIMA (Rothschild and Hartert).

Geospiza dubia similllima ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 161, 1899 (Charles Island).

Geospiza simillima RIDGWAY, Bull. U. S. Nat. Mus., No. 50, Pt. I, p. 502, 1901.

Range. — Charles Island.

This form is described by Rothschild and Hartert from one adult male and four immature birds as differing from *G. f. fortis* of Albemarle (comparisons probably made with specimens from Villa Mil at the southeast part of Albemarle) in having the wing from two to three millimeters longer. If this is a valid species really different from *G. f. fortis* on Charles, we have one immature male that is probably referable to it. This specimen measures as follows: length 130; wing 75; tail 49; culmen 20; gonys 10; basal width of bill 11, basal depth of bill 15.5; maxilla from nostril 13; tarsus 22. It was taken in May and is moulting.

63*f*. GEOSPIZA FORTIS BAURI (Ridgway).

Geospiza bauri RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 362, 1894 (James Island), and XIX, p. 518, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 500, 1901.

Geospiza dubia bauri ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 161, 1899.

Range. — James Island.

This variety is known only from three specimens taken on James Island by Baur and Adams. We have not seen specimens of it. According to Rothschild and Hartert, who examined Baur and Adams' specimens, it is subspecifically related to *G. fortis dubia*, differing from the latter only in having a larger beak. It, then, possesses the largest bill of the *G. fortis* series, approaching nearest to *G. strenua.*

64. GEOSPIZA DARWINI Rothschild and Hartert.

Geospiza darwini ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 158, 1899 (Culpepper Island).—RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt. I, p. 500, 1901.

Range. — Culpepper Island.

We did not procure any specimens of this form. The measurements of the beak given by Rothschild and Hartert are included within the dimensions of the bill of *G. strenua.* The adult male differs, however, from that of *G. conirostris*, *G. strenua* and *G. magnirostis*, according to the describers, in having the "feathers of the breast, abdomen and back slightly edged with olive" and in having the rump conspicuously olive. "Bill compressed and rounded, as in *G. conirostris*, but, unlike the other species of *Geospiza*, abruptly narrowed three millimeters from the tip and elongated sharply to the point."

65. GEOSPIZA STRENUA Gould.

Geospiza strenua GOULD, Proc. Zool. Soc. Lond., p. 5, 1837, and Zool. Voy. Beagle, III, Birds, p. 100, pl. 37, 1841. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 155, 1899. — RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt. I, p. 496, 1901.

Geospiza pachyrhyncha RIDGWAY, Proc. U. S. Nat. Mus., XVIII, p. 293, 1896 (Tower Island); Bull. U. S. Nat. Mus., 50, Pt. I, p. 498, 1901.

Range. — James, Bindloe, Abingdon, Tower, Indefatigable, Jervis, Duncan, Barrington, Albemarle, Narboro and Wenman.

Our collection contains one adult male and one adult female from Narboro, taken in January and March; five adult males and one adult female taken on James in April; and nine adult males and three adult females taken on Abingdon, Bindloe and Tower in June. Besides the adults there are numerous young specimens from James, Abingdon, Bindloe and Tower.

The adult males are exactly the same in plumage as adult males of *G. fuliginosa* and *G. fortis.* The specimens are all moulting except those taken on James in April. They were taken on Narboro in April and on Abingdon, Bindloe and Tower in June. This shows that with the adults there is a moult after the breeding season.

The adult females resemble those of *G. fuliginosa* and *G. fortis* in color of plumage, but the bill is generally more or less pale below. Females taken in April and June are moulting; the one taken on Narboro in March is not.

All of the young birds in the collection except one were taken in June. All of these, except one male from Tower, are in Stage II. The one that is not is in a condition between Stages IV and V; the upper mandible is black; the lower mandible is black on the sides, yellowish below. One young female from Narboro was taken in January. It has the plumage of the adult, but the lower mandible is pinkish-yellow.

A nest of this species containing a set of five eggs was secured on Narboro April 5. It was placed a few feet above the ground in the forks of a small bush. In shape it resembles the nests of other *Geospizæ* already described. It is composed exteriorly of plant stems interwoven with lichens and a few grasses, and is lined scantily with bark fibers, finer grasses and a few lichens. The height of the nest is one hundred and fifty millimeters, its width one hundred and sixty, the depth of the interior one hundred and twenty, and the diameter of the entrance five.

The eggs have a pale greenish-white ground color, with a few grayish shell marks and numerous brownish blotches, heaviest about the larger end. Dimensions: 23 × 17.5, 23 × 17, 23.5 × 17, 23.5 × 17, 23.5 × 17.

The song of this species was not often heard. One bird was observed singing at James Bay on James Island. The song had a very pleasing sound, differing considerably from the ordinary *Geospiza* notes. It may be represented as follows: *teu'w.........ē.........ē-leur.* The first greatly prolonged syllable was indistinctly divided into two parts, the second one with the ē-sound being the part specially prolonged. The sound of the first syllable was smooth and continuous, but the second syllable was abruptly different from the preceding. It was slightly prolonged, had a very pure tone, and ended with a rising inflection.

The following table shows that the specimens from Narboro have a somewhat smaller bill and smaller wing than most of the others. More specimens from this island might indicate a separate subspecies for Narboro.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza strenua*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
5168	Tower.	♂	170	86	55	24.5	12.5	16	22	17	23.5
5226	"	"	162	84	51	25.5	13.5	16	22	17	25
5243	"	"	160	86	53	24.5	12.5	16.5	21.5	16	24
5239	"	♀	155	81	50	25.5	13	17	22	16.5	23
5213	"	"	172	87	57	24.5	13	16.3	22	17	25
4590	James.	♂	160	82	51	23.3	12	15	20	15.7	24
4516	"	"	160	86	52	24	11.5	15.5	21	16	25
4511	"	"	162	85	50	23	11.5	15.5	21	15.7	25
4580	"	"	158	85	52	25	12.5	15.5	22.5	17	25
4529	"	♀	163	83	50	23	12	16	20	16.3	24
5051	Bindloe.	♂	160	81	44	24	12.5	15.5	21	16.3	24
5136	"	"	163	81	50	23	11.5	14	19.5	16.7	24.3
5067	Abingdon.	"	168	80	50	24	12.5	15	21.5	16.5	25
4917	"	"	168	80	47	23	12	15	20.3	16	25
5206	"	"	161	81	45	23	12.5	15	21	15	24
4969	"	"	160	79	50	22.7	11.3	15	19.5	15	24.7
5107	"	♀	155	77	47	22.7	12.5	15	19.5	15	23
4414	Narboro.	♂	160	78	50	22.7	11.5	14.5	19.5	16	23
4444	"	♀	159	77	48	20.5	11	13	18	15	23.5

66. GEOSPIZA MAGNIROSTRIS Gould.

Geospiza magnirostris GOULD, Proc. Zool. Soc. Lond., p. 5, 1837 (Charles Island), and Zool. Voy. Beagle, III, Birds, p. 100, pl. 36, 1841. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 512, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, 495, 1901.

Range. — Charles Island.

The specimens from which this species was described were collected by Darwin on Charles Island. No expedition since then has obtained specimens of the species from any of the islands of the archipelago. Rothschild and Hartert give the following measurements of the three adult males in the British Museum: "Culmen 26.5, 27, 27 mm.; height of bill at base 23.5–24 mm.; wing 91, 91, 95 mm.; tarsus 25 mm. These measurements show that *G. magnirostris* has both a larger bill and longer wing than any specimens of *G. strenua* yet obtained, and that the bill is much larger than that of the average *G. strenua* individual.

This ends the side branch begun with *G. fortis fortis* from *G. fuliginosa parvula* leading up to the largest-billed forms of *Geospiza* with the adult females in Stage III. We will now go back to the continuation of the series leading from *G. fuliginosa* through its varieties and through *G. debilirostris* and *G. septentrionales* into the subgenus *Cactornis*, where the females as well as the males acquire a melanistic plumage when adult.

67. GEOSPIZA DEBILIROSTRIS Ridgway.

Geospiza debilirostris RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 363, 1894, and XIX, p. 533, 1896 (James Island); Bull. U. S. Nat. Mus., 50, Pt. I, p. 508, 1901. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 163, 1899.

Range. — James Island.

This species is slightly larger than *G. fuliginosa*, the wing of adult males measuring, according to Rothschild and Hartert, seventy-one to seventy-three millimeters. The basal depth of the bill does not exceed ten and one-half millimeters and is generally less than ten, while the culmen is about sixteen. The bill is, hence, but slightly larger than the bill of *G. fuliginosa difficilis.* On the other hand, the size of the bill and wing in *G. debilirostris* is identical with the measurements of smaller specimens of *G. septentrionalis* and the two species are separable only by the color of the under tail coverts, which, in the second named species, are of a distinct chestnut tone. Hence, in shape of the bill *G. debilirostris* is intermediate between *G. fuliginosa difficilis* and *G. septentrionalis*, and therefore between the former genera *Geospiza* and *Cactornis.* It is probable that if more specimens of *G. debilirostris* could be examined the size of the bill would be found to intergrade with that of *G. f. difficilis.* The difference in length of wing, however, is considerable, so that it is possible that this may be found a specific character.

We have two immature specimens taken in April at James Bay, on James Island, that we refer to this species.

68. GEOSPIZA SEPTENTRIONALIS (Rothschild and Hartert).

Geospiza scandens septentrionalis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 165, 1899 (Wenman and Culpepper Islands). — RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt. I, p. 510, 1901.

Range. — Wenman and Culpepper.

This form is more distinct from those nearly related to it than was indicated by its describers. The bill in the smallest billed specimen is not different from that of the last species, *G. debilirostris*, and on the other hand the bills of the larger specimens intergrade in size with those of the next species, *G. scandens.* In shape the bill resembles more nearly than does that of any other species the beak of *G. conirostris propinqua.* One Culpepper specimen has an unusually large bill, the culmen measures eighteen millimeters, the width at the base is seven and three tenths millimeters, the greatest depth at the base nine and one half millimeters. The smallest billed specimen of *G. c. propinqua* has a culmen of eighteen and one half millimeters. The width of the bill is ten millimeters and the greatest depth thirteen millimeters. One adult male has a deep groove on each side of the culmen running from the nostril, parallel with the curvature of the culmen, to the tomium, exactly as does one of the specimens of *G. c. propinqua* from Tower. Some of the others have less distinct grooves.

Hence in the shape of its bill this species might be related in three different directions with the *G. fuliginosa* series through *G. debilirostris*, with the *G. scandens* series (both of these being very close), and finally, but not so closely, with *G. conirostris* through *G. c. propinqua*.

The adult males differ from the other species of *Geospiza* in having the pale marginal parts of the under tail coverts of a very decided rusty or even chestnut color. This is the only character by which the form can be specifically separated from either *G. debilirostris* or *G. scandens*.

We have no females which are surely adults. All of the female specimens in the collection have yellowish bills, or yellowish with dusky at the base and at the tip. They are plain brown above with the feathers edged with buff; below heavily streaked with dark brown except on the middle of the abdomen, which is plain buffy whitish. All of these have prominent wide rusty almost chestnut edgings to the middle and greater wing coverts.

Two other clearly young specimens, one a female and the other a male, having purely yellow bills, have the spots below mostly confined to the breast and the region in front of it. The abdomen is whitish in the middle, strongly shaded with buff on the sides and on the flanks. The wing coverts have bright chestnut borders.

Two adult males of *G. conirostris propinqua*, including the specimen of this species from Culpepper, have a slight tinge of chestnut on the under tail coverts.

The fact of the similarity of shape between the bills of *G. septentrionalis* and *G. conirostris propinqua*, the occasional occurrence of grooves on the sides of the upper mandible in each, and the exceptional presence of a chestnut color on the under tail coverts of the latter species — a marked characteristic of the former — might be taken as evidence of a derivation of *G. conirostris* direct from *G. septentrionalis*. But since the bills of some specimens of *G. conirostris propinqua* can almost be duplicated by bills of *G. scandens rothschildi*, which stands at the top of the *G. scandens* series, and since the dark color of the adult females and young in *G. conirostris* is simply the maximum of the tendency shown by the whole *G. scandens* series, we think it most logical to regard *G. conirostris* as following naturally *G. scan-*

dens rothschildi. The gradation in size and shape of the bill from *G. septentrionalis* into *G. scandens* through *G. s. scandens* is complete. Hence we begin *G. scandens* with this subspecies.

MEASUREMENTS OF *Geospiza septentrionalis*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus.
3847	Culpepper.	Ad. ♂	130	73	45	17	9	7.7	9.7	11	22
3848	"	"	140	73	47	16	9	7.3	10	10.7	23.7
3849	"	"	145	70.5	44	16	8.5	7	9.3	10.5	22
3850	"	"	148	74	45.5	16.5	8.7	7.7	9	11	22
3892	"	"	145	72	48	17	9	7.3	9	11.3	22
3901	"	"	154	74	48	18	9.5	7.5	9.3	12	22
3851	"	Im. ♀	143	69	45	16	8.7	7.3	9.5	10.5	22
3873	Wenman.	Ad. ♂	125	72	44	16	8.5	6.7	9	10	22
3875	"	"	130	74	47	15	8.5	7.3	8.5	9.7	22
3863	"	"	135	72.5	46	17	9.5	7	8	11.5	22
3864	"	"	135	71	49	16.5	9	7.5	9	11	22
3857	"	"	143	69	47	16.5	9	7.3	9.3	11	23
3870	"	Im. ♀	137	70	44	16.5	9	7	8.7	11	21.5
3856	"	"	140	69	42	15	8.7	7	7.5	10	21.5
3867	"	"	122	69	42	15	8	7.3	9	10	21
3874	"	"	133	67.5	42	15.7	8.7	6.7	8	11	20.7
3865	"	"	130	68	45	16	8.7	7	8.5	11	20.7
3871	"	"	—	64	—	16.5	8	7	8.3	10.5	22
3872	"	"	136	68	43	16	8.5	6.5	9	10.5	20

Subgenus **Cactornis** Gould.

Cactornis GOULD, Proc. Zool. Soc. Lond., p. 6, 1837. (Type, *Cactornis scandens* Gould.)
Geospiza Gould (in part).

Adult males same in color as adult males of *Geospiza* proper. Sexes dissimilar. *Adult females and young blackish*, either in plumage corresponding with Stage IV of young males of *Geospiza* and *Camarhynchus* or in Stage V. Bill various, either elongate and slender or thick and conical.

This subgenus was formed by Gould for slender billed *Geospizæ* such as *G. scandens*. However, a distinction between *Geospiza* and *Cactornis* based on the bill does not hold, but the type of Gould's *Cactornis* can be retained as the type of a distinct group based on color as given in the last paragraph. The adult females are continuously dusky over the upper and anterior parts, and the abdomen is heavily streaked with dark brown. Young birds in the first plumage resemble the adult males except that they have the rufous wing bands invariably characterizing birds of the age of Stage II of the other subgenera.

69. THE GEOSPIZA SCANDENS SERIES.

The variation in the shape and size of the bill in this series amounts to but little. We begin with the smallest billed variety which follows naturally *G. septentrionalis*, and end with the largest billed form, *G. scandens rothschildi*, which leads easily into *G. conirostris propinqua*, and this into the again conical billed form, *G. conirostris conirostris*.

The plumage of the varieties of *G. scandens* differs from that of any of the forms so far described in that the adult females and the young present a strongly melanistic phase. Adult females instead of being pale brown spotted forms as in *G. fuliginosa* and *G. fortis* are continuously dusky over the back, head, and throat, corresponding with Stage V of immature males of *G. fuliginosa* instead of with Stage III as do the adult females of this species. Young birds of both sexes soon after leaving the nest acquire the same dusky plumage of the adult females except that they have the rufous borders to the wing coverts characteristic of birds of their age. The varieties from Abingdon and Bindloe present the maximum of this melanistic tendency in the female and young reached by any forms of the species. The next species, however, *G. conirostris*, is still blacker in these forms and represents the farthest advance toward complete melanism attained by the genus.

The forms now included under the species *G. scandens* were regarded by Gould as constituting a distinct genus, *Cactornis*. The intergradations at each end with other forms, however, are, as has already been recognized by Ridgway and by Rothschild and Hartert, unbroken. Rothschild and Hartert regarded *Camarhynchus pallida* as being intermediate between the genera *Camarhynchus* and *Geospiza*. This may be true of the bill, but, as we have already shown, the plumage of *C. pallida* separates it widely from any species of *Geospiza*, and especially from those which it most resembles in the shape of the bill.

69*a*. GEOSPIZA SCANDENS SCANDENS (Gould).

Cactornis scandens GOULD, Proc. Zool. Soc. Lond., p. 7, 1837 (James Island); Zool. Voy. Beagle, Birds, p. 104, pl. 42, 1841.

? *Cactornis assimilis* GOULD, Proc. Zool. Soc. Lond., p. 7, 1837 (? Charles Island according to Rothschild and Hartert, Bindloe Island according to Gould which cannot be correct); Zool. Voy. Beagle, Birds, p. 105, pl. 43, 1841.

Geospiza intermedia RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 361, 1894 (Charles Island), and XIX, p. 535, 1896.
Geospiza scandens RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 534, 1896 (James Island); Bull. U. S. Nat. Mus., 50, Pt. I, p. 509, 1901.
Geospiza scandens scandens ROTHSCHILD AND HARTERT, Novit. Zool., XI, p. 164, 1899 (James Island).
Geospiza scandens intermedia ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 164, 1899 (Charles Island).

Range. — James and Charles.

We cannot distinguish any difference between the specimens of this species from Charles and those from James. The measurements of the bills in the two sets are the same. The smallest ones intergrade in size with the bills of *G. septentrionalis*.

Our collection contains ten males in black plumage and two adult females taken on Charles in May, and seven adult males and five young birds taken near James Bay on James Island in April. The adult females are very dark, being continuously dusky over the back, head, throat and breast. The young birds from James are in Stage I. They were taken April 22.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza scandens scandens*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
4713	Charles.	♂	142	70	45	19	11	8	9.5	14	17.5
4715	"	"	140	70	44	18	10	8	9.7	12.5	21.5
4884	"	"	152	72.5	45	18	10	7.5	10	12.5	21
4708	"	♀	146	71	46	20.5	10.5	8	9.5	14	20.5
4735	"	"	130	67	43	19	10.3	7.3	8.7	13.5	21
4594	James.	♂	140	73	45	19.5	11	8	10	13.5	21
4596	"	"	136	69	41	18.5	10.3	7.5	8.7	13	21
4597	"	"	140	68	46	20	11.5	8.3	9.7	13.7	22.3
4592	"	"	128	71	45	18	11.3	7.5	8	13	20
4518	"	"	129	70	46	18	10	7.3	9.5	12.3	20.7
4596	"	"	126	68	47	18.5	10	7.7	9	13	20
4542	"	"	135	70	44	19	11	7.5	8.5	13.5	19

On James this species was found rather common some distance inland from James Bay where the vegetation was heavier. None of these birds was seen near the beach. Some of the males were heard singing a song sounding like *teu'-lee*, *teu'-lee*, *teu'-lee*, *teu'-lee*. Two birds specially observed always repeated the set of two syllables four times in succession. The tone of the voice resembled exactly that of the conical-billed *Geospizæ*. Another song that was heard more frequently than the last resembled *teur'-wee-wee*, *teur'-wee-wee*, *teur'-wee-wee*. In each set the first syllable carried the accent and was separated from the second by a longer interval than that between the second and the third. Many were heard uttering a song sounding like *bŭr'-tee-tee-tee*, *bŭr'-tee-tee-tee*.

The species was about as abundant on Charles as on James, but was found much nearer the coast.

69*b*. GEOSPIZA SCANDENS FATIGATA (Ridgway).

Geospiza fatigata RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 293, 1895 (Indefatigable Island), and XIX, p. 539, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 511, 1901.

Geospiza barringtoni RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 361, 1894 (Barrington Island), and XIX, p. 541, 1896.

Geospiza scandens fatigata ROTHSCHILD AND HARTERT, Novit. Zool., p, VI. 164, 1899.

Range. — Indefatigable, Seymour, Barrington, Chatham, Duncan, Jervis and Albemarle.

This form differs from *G. s. scandens* in the slightly larger bill. We have adult specimens from only Seymour and Barrington; the two sets are indistinguishable from each other. Immature specimens from Seymour, Indefatigable and Albemarle are apparently the same, but those from Chatham have the bill considerably shorter and thicker, more as in the young of *G. s. abingdoni*.

The adult females of this species are much darker than females of *G. fuliginosa*, *G. fortis*, etc. The back, top and sides of the head and the throat are continuously dusky. The spots of the breast and abdomen are dark dusky brown. The collection contains six adult females, all of which are colored thus and absolutely duplicate the color of males in Stage IV of *G. fuliginosa* and the *G. fortis magnirostris* series.

Young specimens of both sexes taken in April vary in plumage from Stage I to Stage III of *G. fuliginosa*, etc., except that they all have the wide rufous bands on the wing coverts, indicating, together with the date, that they are birds of the same season. The bills of all are dusky above, yellow below. The collection contains three immature specimens from Iguana Cove, Albemarle, taken in June. One is a male, whose plumage is entirely dusky except for pale tips to the feathers of the abdomen, but the bill is blackish only at the base, the rest being yellow. It has distinct but narrow rufous edgings on the wing coverts. The other two young specimens, the sex of which is undetermined, are in the plumage of Stage III, the wing coverts have wide bands of rufous and the bill is dusky above, yellow below. Two immature specimens from Chatham taken in May are in the plumage of Stage III.

On southern Seymour we found this species very common during the last of April and the first of May. The most common song uttered by the males consisted of a simple series of similar notes, thus: *tlee-tlee-tlee*, etc., the song consisting sometimes of only three or four notes but generally of a larger number — six or seven. They sang also another song which resembled *teur'-wër-wër*, *teur'-wër-wër*, *teur'-wër-wër*, this one being very much like one of the songs of *G. fortis*. A third sound that they uttered, but infrequently, was somewhat like *zee'-eurp*. This they uttered singly, *i. e.*, they never repeated the set of two syllables several times in succession so as to make a more prolonged "song."

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza scandens fatigata*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Basal Width of Bill.	Basal Depth of Bill.	Maxilla from Nostril.	Tarsus
4978	Barrington.	♂	154	70	44	19	11	8	11	13.5	20
5007	"	"	155	71	41	19	11	8	10	13	21
4982	"	"	140	72.5	43	20	10.7	8.3	10.5	14	22
4943	"	"	150	71	46	21	12	8.5	10.5	15	21
4994	"	"	138	71	41	20	11	8.3	10.7	14.5	21.5
4947	"	"	148	70	42	21.5	12	8.3	11.5	16	21.5
4991	"	"	129	71	41	18.5	10.5	8	10.5	13	21.5
4920	"	"	144	69	39	20	11.3	8	10	14.5	21.5
4954	"	"	147	72	38.5	20.5	11.7	9	11.3	14.5	22
4950	"	"	154	71	44	20.5	11	8.5	10.5	13.7	23
4951	"	"	142	70	44	21	11.5	8	10.3	14.7	21.5
4979	"	"	146	69	42	20	11	9	11	14	21.5
4963	"	"	147	71	39	21.5	12.5	8.7	10.5	15	23
4968	"	♀	135+	69	—	21.5	12	8.5	10.5	15	21.3
4983	"	"	140	68.5	39.5	21	11.5	8.3	10.5	15	21.5
4938	"	"	141	65	40	19	10.5	8	10	13	21
4995	"	"	140	68.5	38.5	19	11.5	7.7	10	14	20.5
4675	South Seymour.	♂	144	71	45	21	11	8.5	11	14	21.3
4650	" "	"	—	67	—	18.5	10	8	10.5	12.5	22
4666	" "	"	146	71	42.5	22	12.5	8.7	11	16	22.5
4687	" "	"	145	69	44	21	12	8.5	10	15	20
4628	" "	"	148	72	41.5	22	12	9	10.3	15.7	22.5
4653	" "	"	150	72.5	42.5	21	11.5	8	9.3	14	21.5
4672	" "	"	144	71	43	21	11.5	8	11	14.7	21.7
4638	" "	"	145	68	42	20	11.3	7.7	9.5	13	21
4642	" "	"	146	68.5	45	20.5	11	8	10	14	21
4627	" "	"	136	67	42	20.5	11.7	8	10.3	14.5	22
4648	" "	♀	143	70	43	20	11	8	10	14.5	20.5
4700	" "	"	148	69.5	41	21	12	7.7	10	15	21

On Barrington we found the species even more abundant than on Seymour. Males in black plumage here predominated. The species is rare on Albemarle, we found it only at Iguana Cove where but three immature specimens were secured. We have also three immature specimens from Chatham, but we did not find the form on Duncan.

69*c*. GEOSPIZA SCANDENS ABINGDONI (Sclater and Salvin).

Cactornis abingdoni SCLATER AND SALVIN, Proc. Zool. Soc. Lond., pp. 323, 326, 1870 (Abingdon Island).

Geospiza abingdoni RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 540, 1896 (Abingdon Island); Bull. U. S. Nat. Mus., 50, Pt. I, p. 513, 1901.

Geospiza scandens abingdoni ROTHSCHILD AND HARTERT (in part), Novit. Zool., VI, p. 165, 1899 (Abingdon and Bindloe).

Range. — Abingdon.

Birds of this species from Abingdon and Bindloe can be distinguished from each other by the larger size of the Bindloe bill. *G. s. abingdoni* is very close to *G. s. fatigata*, differing from it in the slightly deeper bill, being in this respect intermediate between it and *G. s. rothschildi* of Bindloe Island.

MEASUREMENTS OF IMMATURE SPECIMENS OF *Geospiza scandens abingdoni*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
5188	Abingdon.	♂	148	71	45	20.3	11	8.3	10.3	14.3	21.7
5044	"	"	140	72	44	21	12	8.3	10.3	14.7	22.5
5070	"	"	146	72	48	20.5	11	8.5	10	14.3	22
5113	"	"	145	72	42	20	11.3	8.5	10	14.3	22
5047	"	"	142	71	47	20	11.5	7.7	11	14.0	22
4931	"	♀	155	72	46	21	12	8.5	11	14.5	22.5
5283	"	"	138	63	39	19.5	11	8.3	10.3	13.3	20.5
4930	"	"	140	69	39	20	11	8	11	14.5	21

From both Abingdon and Bindloe we have only immature specimens in the collection. Nearly all are in plumages corresponding with Stages III and IV, but have rufous bands on the wing coverts and bills either entirely yellow or mostly yellow with some dusky above. These specimens are the blackest of all the varieties of *G. scandens* in immature stages. They are almost as dusky as the adult females and young of *G. conirostris*.

69*d*. GEOSPIZA SCANDENS ROTHSCHILDI
Heller and Snodgrass.

Cactornis assimilis SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, 1870 (Bindloe Island).— SALVIN, Trans. Zool. Soc., IX, p. 486, 1876 (Bindloe Island).— SHARPE, Cat. Birds Brit. Mus., XII, p. 18, 1888 (Bindloe) (*probably not C. assimilis of Gould which did not come from Bindloe*).
Geospiza assimilis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 537, 1896 (? James and Bindloe) (*probably not of Gould*).
Geospiza scandens abingdoni ROTHSCHILD AND HARTERT (in part), Novit. Zool., VI, p. 165, 1899 (Abingdon and Bindloe Islands).
Geospiza scandens rothschildi HELLER AND SNODGRASS, The Condor, Vol. III, No. 3, May, p. 75, 1901 (Bindloe Island).
Geospiza rothschildi RIDGWAY, Bull. U. S. Nat. Mus., 50, Pt. I, p. 673, 1901.

Range. — Bindloe.

This species is very similar to *G. s. abingdoni* but the bill is considerably thicker, being the heaviest of all the varieties of *G. scandens*. The basal depth is equal to the length of the gonys.

Only immature birds are in the collection but these differ so conspicuously from specimens of *G. s. abingdoni* of the same age that it is very probable that adults will be found to differ correspondingly. Some of the thickest billed specimens have bills almost as large as some of the smaller billed specimens of *G. c. propinqua* from Tower. The measurements of the bill of one young specimen of *G. c. propinqua* of the same age as the Bindloe specimens are as follows: culmen 19, width of bill at base 10, greatest depth at base 12. This, it will be seen by comparison with the table of measurements of *G. s. rothschildi*, is extremely close to the bill proportions of some specimens of this species.

MEASUREMENTS OF IMMATURE SPECIMENS OF *Geospiza scandens rothschildi*.[1]

Cat. No. Stan. Univ. Mus	Locality.	Sex.	Length.	Wing.	Tail	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
5146	Albemarle, Iguana Cove.	♂	148	72	45	21.5	12	9.5	12	15	20
5237	" "	"	141	71	41	20	11.5	8.5	11.5	14	20
5145	" "	"	147	69	43	21.5	12	9	11.5	15.5	23
5122	" "	♀	152	71	44	19.5	11	9	11.5	14	21.7
5173	" "	"	140	67	43	20.5	10.5	8.5	11	14.5	21.5
5175	" "	"	145	71	40	20	11	8	11.5	14	22
5163	" "	"	144	65	38	20	11	8	10.5	14	20.5

[1] Rothschild and Hartert (Novit. Zool., IX, p. 398) retain the Bindloe form under *G. s. abingdoni*. Their measurements of the bill depth for Abingdon specimens, however, vary from 10 to 10.5, and for Bindloe specimens from 11 to 12.

Hence there is almost a perfect gradation through this subspecies from the slender billed *Cactornis* group to the next species, *G. conirostris*, which ends at the top of the *Geospiza* series with a bill again enlarged and conical and with very dark plumage in the adult female and young.

The remarks on the plumage of *G. s. abingdoni* apply also to this form.

This species is not common. All our specimens were taken about the middle of June. We did not even see any adult individuals.

70. THE GEOSPIZA CONIROSTRIS SERIES.

This species presents probably the greatest variation in the size and shape of the beak of any of the species of *Geospiza*. Two apparently well separated species were formerly described by Ridgway from the extremes of *one subspecies*, *G. c. conirostris*, living on Hood. The bill in shape resembles that of *G. f. fortis*, differing from it at one end of the series, mainly in being larger. The species comprises two subspecies, of which *G. c. conirostris* of Hood has the larger and more conical beak, resembling in shape that of *G. f. fortis;* while the other, *G. c. propinqua* of Tower and Culpepper, has a more slender beak resembling in shape that of *G. septentrionalis* of Culpepper and in both shape and size in some cases that of *G. scandens rothschildi* of Bindloe. The size of the bill of an average specimen measures as follows: Culmen 22, gonys 11.5, width of bill at base 12, depth at base 16.5. The variations are as follows: Culmen 19 to 24, gonys 10 to 14, width of bill at base 10 to 13.5, depth at base 13 to 18. All of these variations in size occur within the subspecies *G. c. conirostris*, but the bill of *G. c. propinqua* averages smaller than that of *G. c. conirostris*.

The plumage of this species presents the farthest advance toward complete melanism, *i. e.*, of both sexes and all ages, attained by any species of *Geospiza*. It reaches a stage farther in the females and young than it does in the last species. The adult females have a greater amount of dusky on them than do males of *G. fuliginosa*, *G. fortis*, etc., in Stage IV, since the belly, instead of being mostly pale, is heavily streaked with dark brown. The back, head, throat and breast are continuously blackish-brown, except that the feathers of the back have slight brownish edgings. The young soon after leaving the nest resemble the females.

The fact that the beaks of the smallest billed individuals of this species are so close in shape and size to those of the largest billed individuals of the last, *i. e.*, those living on Bindloe, and the fact that the melanistic tendency in the adult females and young in the Bindloe form of *G. scandens* approaches nearest in degree to that of *G. conirostris*, indicates a natural transition from *G. scandens* to *G. conirostris.* The few facts that might be taken as evidence of a relationship between *G. c. propinqua* and *G. septentrionalis* have already been given under the latter species.

Since, in the general evolution of the groups *Cactospiza*, *Camarhynchus*, *Geospiza* and *Cactornis*, the color of the plumage is seen to be a much more constant character than the size and shape of the bill, and a characteristic, in all other cases, of apparently natural groups, we see no reason why it should not be relied on in the case of *G. conirostris*, and be made the basis for including this species in the group *Cactornis.* Taking the color as the more fundamental character in the classification of all these groups, and the shape of the bill as a secondary one, then *G. conirostris conirostris* must be regarded as the most specialized of all the *Geospizæ*, and be placed at the top of the series, a position that has by all previous writers in the genus been given to *G. magnirostris.*

70*a*. GEOSPIZA CONIROSTRIS PROPINQUA (Ridgway).

Geospiza propinqua Ridgway, Proc. U. S. Nat. Mus., xvii, p. 361, 1894 (Tower Island), and xiv, p. 543, 1896; Bull. U. S. Nat. Mus., 50, Pt. 1, p. 499, 1901.
Geospiza conirostris propinqua Rothschild and Hartert, Novit. Zool., vi, p., 159, 1899.
Geospiza conirostris subsp.? Rothschild and Hartert, Novit. Zool., vi, p. 160, 1899 (Culpepper Island).

Range. — Tower and Culpepper.

We have seven adult males from Tower taken in June, one adult male from Culpepper taken in December, and two young males and two young females from Tower. We apparently have no adult females.

The shape of the bill in this subspecies is very similar to that of *G. c. conirostris.* Between the bills of some specimens from Tower and Hood there is absolutely no difference, but the bill of the Hood Island variety averages larger. The bill of *G. c. propinqua* generally has a more curved culmen and less acute tip.

The collection contains eight adult males. Two of them have not quite reached the purely black phase of Stage V, having a few narrow whitish edgings to the feathers of the lower part of the abdomen and a few brownish feathers on the back. Two specimens have a slight tinge of chestnut on the under tail coverts. Most of these males are moulting. The bills are very pale, being either dusky brown all around, or having the upper mandible dusky and the lower pale brownish or even pinkish-yellow; one purely black specimen has also the sides of the upper mandible yellowish. The male from Culpepper taken in December has the bill blackish-brown except the sides of the base of the lower mandible which are yellowish-brown. Immature males resemble those of *G. c. conirostris* but the feathers of the back are widely margined with grayish-buff; they also lack, in most cases, conspicuous buffy edgings to the greater and middle wing coverts, although one specimen has them well developed. We have no female specimens that appear to be mature, but, from the light color of the bill in the adult male, one would expect to find a still paler bill in the female.

The bill of one specimen has a distinct groove on each side of the upper mandible, running from the nostril, in a curve parallel with the culmen, to the tomium. Another has a less distinct groove in a similar position on the left side of the upper mandible.

The following measurements show that the Culpepper specimen does not differ from the Tower specimen. They show also the intergradation between this form and the one on Hood, and the small difference between this species and *G. scandens rothschildi*.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza conirostris propinqua*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
5214	Tower.	♂	155	76	48	21	12	11	14.5	14.5	23
5109	"	"	145	74	47	18.5	10.5	10	13	13.5	23
5233	"	"	150	73	45	19	11	10	13	14	23
5005	"	"	150	74	42	21	11.5	10.3	14	15	22.5
5281	"	"	155	78	53	21.5	11.5	11	14.7	15	24.5
5129	"	"	140	73	49	20	10	10	13	13	24
5171	"	"	146	76	45	21	11	10	13	14	22
3905	Culpepper.	"	160	77	51	20	10.5	10	14	13.5	24

70*b*. GEOSPIZA CONIROSTRIS CONIROSTRIS (Ridgway).

Geospiza conirostris RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 106, fig. 2, 1890, and Proc. U. S. Nat. Mus., XIX, p. 516, 1896 (Hood Island); Bull. U. S. Nat. Mus., 50, Pt. 1, p. 498, 1901.

Geospiza media RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 107, fig. 3, 1890 (Hood Island).

Geospiza conirostris conirostris ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 158, 1899 (Hood Island).

Range. — Hood and Gardner near Hood.

The collection contains sixteen adult males mostly in pure black plumage. One bird, however, has the primaries almost reddish-brown, contrasting strongly with the rest of the plumage including the tertiaries. This bird is moulting and besides the brown wing feathers it has a few brown feathers scattered about over the back. One male having a black bill is in a plumage intermediate between Stages IV and V of *G. fuliginosa.*

Adult Females. — The adult female differs greatly from the females of other species in being as black as males of other species in Stage V. Upper parts blackish or blackish-brown, feathers of the middle of the back with grayish or light brown edgings. Primaries and secondaries brown, edged with rusty, in strong contrast with the black of the dorsum. Tertiaries black, edged with buffy gray. Rectrices sooty brown, sometimes edged with rusty. Sides and lower part of head, throat and breast black or blackish-brown. Feathers of lower breast, abdomen, sides and crissum with sooty brown central areas and wide buffy gray margins, giving a strongly streaked appearance to these parts. Bill blackish-brown above, paler brown below, blackish at tip and base. Feet blackish-brown.

There are four immature males and three immature females in the collection. The bills are black above, but are almost entirely pale below, the lower mandible having black only about the base and at the tip. These birds are evidently, judging from the condition of the bill and the general appearance of the feathers, but recently from the nest, *i. e.*, they correspond in age with Stage I of *G. fuliginosa* and *G. fortis.* They are in a plumage, however, very similar to that of the adult female except that they have certain characteristic marks of the young. The head all around, back, throat and breast are black or blackish-brown, the feathers of the back are edged more or less with buff. The wings are sooty brown. The middle and greater wing coverts are widely edged with rusty buff, a character belonging only to Stage I of other species. The abdomen, sides and under tail coverts are heavily streaked with blackish or sooty brown on the central parts of the feathers, the marginal parts of the feathers being buffy white.

This species was abundant on Hood in May. Their song was considerably different from that of other species of *Geospiza* and in itself presented a large amount of variation. One bird was heard singing a song resembling *tlee-leé-oo*, *tree-leé-oo*, *tlee-leé-oo*. The consonant sound was various and is hard to represent by the sound of letters. Another bird was heard uttering a song sounding like *cheé-you-hoo*, *cheé-you-hoo*, *cheé-you-hoo*. The space between the second and third syllables in each set was longer than that between the first and second, A third bird sang the following song: *cheé-ee-oo*, *cheé-ee-oo*, *cheé-ee-oo*. Another sang *chēē'-woo*, *chēē'-woo*, *chēē'-woo*. Still another bird sang a song resembling *twee'-ŭ'r'r'r-rwŭ*, the *r*-sound in the second syllable being trilled.

MEASUREMENTS OF ADULT SPECIMENS OF *Geospiza conirostris conirostris*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Gonys.	Width of Bill at Base.	Depth of Bill at Base.	Maxilla from Nostril.	Tarsus.
4805	Hood.	♂	135	77	43	21.5	12	12	16	15	23
4809	"	"	142	76	44	22	11.5	11	15	15	21
4877	"	"	147	72	45	21.7	12	11.7	16.5	15.5	22
4842	"	"	160	78.5	47	24	14	13.5	18	17.5	24.3
4839	"	"	158	78	45	23	12.5	12	16.5	16.3	23
4890	"	"	155	81.5	51	23	13	13	18.5	16	22.5
4757	"	"	151	80	45.5	23.5	11.5	10.7	15.5	15	23
4874	"	"	142	77.5	40	22	12	11	16	15.5	22
4883	"	"	155	78	47	22	11.5	12	16.5	15	23
4815	"	"	150	76	44	21.5	12	11.7	17	15.3	23.5
4898	"	"	152	80	47.5	22.5	11.5	12	16	15.7	21.5
4719	"	"	142	77	43	22.5	12.5	11.7	16.5	16	22
4750	"	"	145	76	44	22	11.3	12	16.5	16.5	21.5
4860	"	"		68		19	10.5	10	13	13	22
4849	"	"	153	78	47	21.5	11.5	10.7	15.5	15	23
4862	"	♀	140	74	38	21	12	11.5	15.7	15	20
4893	"	"	149	72	46	22	12.5	12	16	16	22
4810	"	"	145	76	46	22	12	12	16	14.7	22

The following are species of doubtful existence. It may be that the *types* from which they were described are simply "aberrant" forms of some of the well established species. In any case there is not at present enough material in museums to decide their status.

(*a*) GEOSPIZA DENTIROSTRIS Gould.

Geospiza dentirostris GOULD, Proc. Zool. Soc. Lond., p. 6, 1837; Zool. Voy. Beagle, III, Birds, p. 102, 1841. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 532, 1896; Bull. U. S. Nat. Mus., 50, Pt. I, p. 507, 1901. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 163, 1899.

Range. — Charles.

Described from specimens in the British Museum taken by Darwin. No specimens referable to it taken since. Probably aberrant individuals of *G. fortis fortis*, characterized by possession of a toothed mandible.

(*b*) GEOSPIZA SPEC. INC. Rothschild and Hartert.[1]

Geospiza spec. inc. ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 163, 1899 (Chatham Island).

Range. — Chatham.

Described as resembling *G. dentirostris* in proportions, but lacking the "tooth" of the upper mandible of that species. One adult male, described by Rothschild and Hartert, taken on Chatham by Baur and Adams.

(*c*) GEOSPIZA BREVIROSTRIS Ridgway.

Cactornis brevirostris RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 108, 1890, fig. 4; Bull. U. S. Nat. Mus., No. 50, Pt. I, p. 514, 1901.
Geospiza conirostris brevirostris ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 159, 1899 (Gardner Island, near Charles).

Range. — Charles.

Described from an immature specimen collected by the *Albatross*. Besides this specimen there is one taken by the Harris expedition and described by Rothschild and Hartert as differing from *G. conirostris conirostris* in having a slightly smaller and narrower beak.

Family HIRUNDINIDÆ.

Genus **Progne** Boie.

Progne BOIE, Isis, p. 971, 1826.

Range. — Temperate and tropical America. One peculiar Galapagos species.

71. PROGNE MODESTA (Néboux).

Hirundo concolor GOULD, Proc. Zool. Soc. Lond., p. 22, 1837 (Galapagos Archipelago).
Hirundo modesta NÉBOUX, Rev. Zool., p. 291, 1840 (Charles Island).
Progne modesta RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 505, 1896.
Progne concolor ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 152, 1899.

Range. — Charles, Chatham, Barrington, Indefatigable, Seymour, James and Albemarle.

This swallow is very abundant at some places in the archipelago. We found it most numerous near Elizabeth Bay, on the north shore of the southern half of Albemarle. We obtained it also at Tagus Cove

[1] This form has been named *Geospiza harterti* by Ridgway (Bull. U. S. Nat. Mus., 50, Pt. I, p. 507, 1901) and its standing as a species confirmed later by Rothschild and Hartert (Novit. Zool., IX, p. 397).

on Albemarle, and on the southern Seymour Island. The birds inhabited the crevices of the tufa cliffs facing the ocean about Tagus Cove.

MEASUREMENTS OF ADULT SPECIMENS OF *Progne modesta*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
3943	Albemarle, Tagus Cove.	♂	177	123	67	10	7.5	12
3897	" "	"	170	125	65	11	7.5	12
4195	" "	"	173	126	68	11	7	12.5
3909	" "	"	170	123	66			12
4121	" "	♀	163	121	62	10	6.5	11.5
4118	" "	"	166	119	63	11	7	12.5
3888	" "	"	167	120	64	11	6.7	12
4219	" Elizabeth Bay.	"	170	122	60	10	7	11.5
4701	Seymour.	"	177	120	68	12	7	11

Genus **Hirundo** Linn.

Hirundo LINNÆUS, Syst. Nat. ed. 10, I, p. 191, 1758.

Range. — Cosmopolitan.

72. HIRUNDO ERYTHROGASTER Bodd.

Hirundo erythrogaster BODD., Tabl. Pl. End., p. 45, 1873.

Hirundo rustica erythrogastra ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 152, 1899.

Range. — Breeding in North America, migrating into Central and South America. Galapagos Archipelago: Charles, Chatham and Hood.

We did not obtain any specimens of this species, but in May we saw several individuals flying about over Hood. The time of the year would lead one to suppose that they are resident in the archipelago.

Family **MNIOTILTIDÆ.**

Genus **Certhidea** Gould.

Certhidea GOULD, Proc. Zool. Soc. Lond., p. 7, 1837 (Galapagos Islands).

Range. — Galapagos Archipelago.

This genus is of doubtful affinities. It was described by Gould as belonging to the Fringillidæ, but was placed in the Cœrebidæ by Sclater and Salvin. Lucas (Proc. U. S. Nat. Mus., XVII, p. 309, 1894) concluded from a study of the anatomy of the genus that it has a "very near relation with *Dendroica*" and that it "surely belongs among the Mniotiltidæ."

Certhidea is peculiar to the Galapagos Archipelago and is known from every island of the group. We have only a small number of specimens, seventy six in all, but the genus has been well discussed by Rothschild and Hartert and we make only a few changes in the disposition of the species as given by these authors. There are eight varieties distinguishable, comprised under two species — *C. olivacea* and *C. cinerascens*, characterized as their names imply, one by an olivaceous color and the other by an ashy tone.

Nothing is certainly known of the nidification and eggs of *Certhidea*. We shot a female of *C. olivacea olivacea* at Iguana Cove, Albemarle, from a nest containing three eggs. The nest was exactly like that of *Geospiza fuliginosa* and the eggs were identical in size and coloration with those of the same species (see p. 310). Hence, since we have no other examples we hesitate in ascribing this nest to *Certhidea*.

The *Certhideæ* are insectivorous, differing thus from most of the *Geospizæ* which live on seeds, but the lowest member of the latter genus, *G. heliobates*, feeds entirely on insects.

The song in some cases resembles the ordinary songs of *Geospiza*, and there is nothing distinctive in their habits. The birds are to be found from the shore to the tops of the highest mountains.

The color of the young is very similar to that of the adult, the only particular specialization of the adults is the rufous or chestnut throat in the males of *C. olivacea*. The following is a description of a typical immature bird. The characters apply to any variety of *C. olivacea*.

Immature Male and Female (*C. olivacea*). — Above almost uniform dull olivaceous, the feathers of the head with dusky centers. Wing and tail feathers dusky brown, both remiges and rectrices edged with the color of the back, tipped with gray. The middle and greater wing coverts broadly edged in most cases with bright rufous. Below pale buffy whitish with a slight olive tinge, brownish-buff along the sides. Bill brownish above, pale below.

By a comparison of this description with the descriptions of the young in the first plumage of the subgenera *Cactospiza* and *Camarhynchus* of the genus *Geospiza*, it will be seen that the two almost duplicate each other (see pp. 277; 284). Furthermore, the rufous wing bands are characteristic of the first plumage of all the *Geospizæ*. This general resemblance in color between the young of these two genera is, in fact, so striking that it is very suggestive of an actual relationship existing between them. If such should be the case, *Certhidea* would be lower than any of the *Geospizæ*, since the adults do not go beyond the condition of "Stage I" in *Geospiza* (see p. 276), being thus nearest to the lowest member of the *Geospiza* series, *G.* (*Cactospiza*) *pallida*.

73. THE CERTHIDEA OLIVACEA SERIES.

73*a*. CERTHIDEA OLIVACEA OLIVACEA (Gould).

Certhidea olivacea GOULD, Proc. Zool. Soc. Lond., p. 7, 1837; Zool. Voy. Beagle, III, Birds, p. 106, 1841. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 498, 1896; Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 763, 1902.
Certhidea salvini RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 358, 1894, and XIX, p. 500, 1896 (Indefatigable Island).
Certhidea albemarlei RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 360, 1894, and XIX, p. 500, 1896 (Albemarle Island).
Certhidea olivacea olivacea ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 148, 1899.

Range. — Indefatigable, Duncan, Jervis, James, Albemarle and Narboro.

Our collection contains of this species twenty two specimens taken in January, February and March at Tagus Cove and Iguana Cove on Albemarle; two from Narboro in March and April; two from James in April; and seven taken in April on Duncan. There are in the lot males with rufous throats from all the islands except Duncan.

The following good description of an *adult male* in full dress is given by Rothschild and Hartert: "Upper side pale olive, pileum and hind neck more olive gray, rump and upper tail coverts lighter and more yellowish-brownish; wings and tail dusky brown, outwardly edged with light olive, inner webs of remiges edged with whitish-gray; upper wing coverts broadly bordered with light reddish-brown, under wing coverts white, strongly washed with buff and yellowish-cinnamon; short superciliary line, extending to about four millimeters beyond the eye; chin, throat and fore neck bright rufous cinnamon; remainder of under surface creamy buff, with an olive tinge; sides washed with olive brown; breast with more or less concealed spots of bright rufous cinnamon; under tail coverts washed with rufous cinnamon." (Novit. Zool., VI, p. 148, 1899.)

The species was not abundant on Albemarle at either Tagus Cove or at Iguana Cove, but was more numerous at the latter place than at the former. The birds are generally rather quiet. At Iguana Cove they sang a song resembling *tw'ül-ee*, *tw'ül-ee*, generally uttering two sets in succession as one song. They uttered also a sound like *twee-twee*. At Tagus Cove the species was rare everywhere but was found in the thick brush at the base and on the side of the mountain back of the cove, and also in the mangrove swamp at Turtle Point. On Narboro it was scarce also, although a few individuals were found in the small areas of vegetation on the sides of the central mountain, and others were seen frequently in the mangrove swamps along the east shore. On Narboro they were heard to sing a song resembling *twĭst'-tĕ-twee . . . ē . . . ē.*

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea olivacea olivacea.*

Cat. No Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4014	Narboro.	♂	110	55	37	11	7.3	18
4423	"	"	110	51	35	10.5	7.5	20.5
4447	"	"	111	51	36	11	7.7	20.5
4153	Albemarle, Tagus Cove.	"	109	51	35	11	7.3	19.5
4169	" " "	"	111	52	40	11	7.5	20
4214	" " "	"	108	54	40	11	7.7	20
4247	" " "	"	110	55	39	10.5	7.5	19.5
4258	" " "	"	104	53	35	10	7.5	20.5
4921	" " "	"	112	53	40	11	7	20
4068	" Iguana Cove.	"	105	52	36	10	7	19.5
4065	" " "	"	105	52	41	11	7.5	21
4098	" " "	"	106	52	38	11	7.7	20
4102	" " "	"	110	50	34	10.5	7	20
4315	" " "	"	112	54	36	10.5	7.5	18
4334	" " "	♀	114	52	37	11.5	7.5	22
4085	" " "	"	101	50	33	11	8	20
4312	" " "	"	115	52	34	10.5	7	19
4321	" " "	"	117	54	35	10.5	7.5	18.5
4612	Duncan.	♂	112	52	36	11	7.5	20
4711	"	"	106	52	35	10	7.3	20
4634	"	"	109	51	39	10.5	7.5	19
4669	"	♀	98	52	32	11	7	18
4517	James.	♂	99	52	34	10	7.5	21

73*b*. CERTHIDEA OLIVACEA LUTEOLA (Ridgway).

Certhidea luteola RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 360, 1894, and XIX, p. 501, 1896 (Chatham Island); Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 764, 1902.

Certhidea olivacea luteola ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 149, 1899.

Range. — Chatham.

There are only four specimens in the collection from Chatham. One adult male has a slight amount of rufous on the throat. The form is very similar to *C. o. olivacea*, differing from it mainly in being a little darker. The length of the bill from the nostril may be slightly longer.

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea olivacea luteola.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4887	Chatham.	♂	113	51	39	11	8	19
4896	"	"	114	53	38	11	8	21
4797	"	♀	121	55	36			20

73*c*. CERTHIDEA OLIVACEA RIDGWAYI Rothschild and Hartert.

Certhidea olivacea ridgwayi ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 149, 1899 (Charles Island).
Certhidea ridgwayi RIDGWAY, Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 765, 1902.

Range.—Charles.

We did not procure any specimens of this species. It is rare on Charles and has been taken only by the Harris expedition. According to Rothschild and Hartert it "differs much from *C. olivacea olivacea* and *C. olivacea luteola* in the much lighter under surface, which wants the olive tinge."

73*d*. CERTHIDEA OLIVACEA FUSCA (Sclater and Salvin).

Certhidea fusca SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, 1870 (Abingdon and Bindloe Islands).—RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 502, 1896; Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 766, 1902.
Certhidea olivacea fusca ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 151, 1899.

Range.—Abingdon and Bindloe.

Slightly darker above and less olivaceous than *C. olivacea olivacea* or *C. o. luteola*, distinguished from these forms by the conspicuous buffy brown wash along the sides and on the flanks. Throat of the male tinged with rufous, and superciliary line of same color present. We have five specimens of this form, including one male with the bill entirely black, taken in June.

The buffy brown color of the sides of the body and the flanks characterizes all the specimens from Abingdon, Bindloe, Tower, Wenman and Culpepper; thus uniting *C. olivacea fusca*, *mentalis* and *becki* as a group inhabiting the northern islands of the archipelago and separating them from *C. olivacea olivacea* of the central islands. The brownish-buff color, however, grades into the less pronounced olivaceous-buff of the same parts in *C. olivacea olivacea* and *C. o.*

luteola. The grouping together of the forms of the more northern islands of the archipelago is similar to what obtains in the genus *Nesomimus*.

MEASUREMENTS OF SPECIMENS OF *Certhidea olivacea fusca*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5238	Bindloe.	♂	115	53	34	11.7	8	18.7
5181	"	"	109	53	43	11	7.7	19
5167	"	♀	112	54	36	11	8	18
5193	Abingdon.	♂	111	51	36	11.5	8	19.7
5266	"	"	111	52	36	11.7	8.5	19.5

73*e*. CERTHIDEA OLIVACEA MENTALIS (Ridgway).

Certhidea mentalis RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 359, 1894 (Tower Island), and XIX, p. 504, 1896; Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 766, 1902.

Certhidea drownei ROTHSCHILD, Bull. Brit. Ornith. Club, VII, p. 53, 1898 (Culpepper Island). — RIDGWAY, Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 767, 1902.

Certhidea olivacea drownei ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 150, 1899.

Certhidea olivacea mentalis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 150, 1899.

Range. — Tower and Culpepper.

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea olivacea mentalis*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5086	Tower.	♂	116	52	38	11.3	7	18
5230	"	"	108	53	38	11.5	8.3	19
5132	"	"	114	55	41	11.5	8	20
5130	"	"	109	53	37	11.5	8	20
5199	"	"	113	54	39	12	8	19
5186	"	♀	114	55	40	12	8.5	19
5123	"	"	105	52	37	12	8.5	19.5
3855	Culpepper.	♂	110	55	39	11.5	8.3	19.7
3852	"	"	110	51	38	11.5	8	19
3854	"	♀		50	33	11	8	19
3853	"	"	113	50	36	11	8	19

We have nine specimens from Tower Island taken in June and four from Culpepper taken in December. We can discover no difference whatever between the two sets of specimens either in color or in proportion. The series as a whole can be distinguished from the six Abingdon-Bindloe specimens of *C. o. fusca* by the slightly darker, more brownish and less olivaceous upper parts. The distinction, however, is very slight. Hence, we combine *C. o. mentalis* (Ridgway) and *C. o. drownei* (Rothschild) into one variety.

73*f*. CERTHIDEA OLIVACEA BECKI (Rothschild).

Certhidea becki ROTHSCHILD, Bull. Brit. Ornith. Club, VII, p. 53, 1898 (Wenman Island). — RIDGWAY, Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 767, 1902.

Certhidea olivacea becki ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 149, 1899.

Range. — Wenman Island.

This form does not differ in color from *C. olivacea mentalis* of Tower and Culpepper. According to Rothschild it should be lighter below than *C. olivacea drownei* (Rothschild) of Culpepper, but our specimens from these two islands show absolutely no difference and, as before stated, do not differ in color from the Tower specimen. The bill of the two Wenman specimens, however, is shorter than the bill of *C. olivacea mentalis*, and apparently the subspecies may be retained on this character. Males have a distinct rufous tinge on the throat, a pale superciliary stripe and an entirely black bill.

We have only two specimens, taken in December on Wenman.

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea olivacea becki*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
3876	Wenman.	♂	107	52	39	10	7.3	18
3866	"	"	109	53	36	10.5	7.5	18

74. THE CERTHIDEA CINERASCENS SERIES.

74*a*. CERTHIDEA CINERASCENS CINERASCENS (Ridgway).

Certhidea cinerascens RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 105, 1889 (Hood Island), and XIX, p. 503, 1896; Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 768, 1902.

Certhidea cinerascens cinerascens ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 151, 1899.

Range. — Hood Island.

Almost no olivaceous shade anywhere. Upper parts, including the wings and the tail, brown, sometimes with an almost inperceptible shade of olive on the rump and upper tail coverts. Feathers of the head and back with grayish shafts. Wing feathers all edged with grayish. Below dull, dirty grayish, tinged with buff on the throat and middle of the breast, slightly washed with brownish along the sides and on the flanks. Auriculars light brown. Superciliary stripe gray. Bill of adults entirely black.

This variety, together with the next, form a well marked species distinguished from *C. olivacea* by the pallid grayish color.

We have fourteen adult males and three immature males of this form taken on Hood and the neighboring small Gardner Island in May. We did not obtain a female. The birds were very abundant about Gardner Bay on Hood. The young associated with one another in small flocks, much resembling thus in habits and appearance the Bush Tits (*Psaltriparus*) of California. Although the breeding season was over, the adults were still singing a great deal. Their ordinary notes consisted of monosyllabic *twits*. The adult males were generally found solitary, not associating with the flocks of young. One song that they sang resembled *tweet'' tĭ' tĭ-tweet'* . . *tweet* . . . *tweet*, the second and third syllables being short and but briefly separated from the one before. The first and fourth syllables were accented, while the fifth and sixth were separated by successively longer intervals. Another song resembled *tweet' tĭ-tweé-ū*.

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea cinerascens cinerascens*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4861	Hood.	♂	108	53	41	10.7	8	18
4873	"	"	109	54	37	11	7.7	19
4904	"	"	108	51	39	11.5	8	18.7
4846	"	"	104	53	38	11	8	19
4848	"	"	108	52	41	10.7	7.5	18.7
4835	"	"	105	51	36	10.5	8	18
4804	"	"	108	51	39	11	8	19
4901	"	"	106	50	38	11	8	19.5
4836	"	"	107	51	37	11	8.3	18.7

74*b*. CERTHIDEA CINERASCENS BIFASCIATA (Ridgway).

Certhidea bifasciata RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 359, 1894 (Barrington Island), and XIX, p. 304, 1896; Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 768, 1902.
Certhidea cinerascens bifasciata ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 151, 1899.

Range. — Barrington.

This form is similar to the last but is paler above and below, almost whitish below with a faint tinge of buff, and with a distinct olive tone above. The tips of the middle and greater wing coverts are specially pale in some specimens forming two fairly well marked bands on the wing.

This form was very numerous on Barrington in May. The young birds, as did those on Hood, remained banded together in small flocks, flying about in troops from one bush to another, continually uttering short *chĭp*-like notes.

We have two adult males and two adult females taken on Barrington in May.

MEASUREMENTS OF ADULT SPECIMENS OF *Certhidea cinerascens bifasciata.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4992	Barrington.	♂	108	51	32	12	8.3	20
4998	"	"	111	53	38	11	8	19
4987	"	♀	108	52	37	11	8.3	18.5
4996	"	"	113	50	35	11	8	17.5

Genus **Dendroica** Gould.

Dendroica GRAY, List Gen. Birds, App. III, p. 8, 1842.

75. DENDROICA PETECHIA AUREOLA (Gould).

Sylvicola aureola GOULD, Zool. Voy. Beagle, III, Birds, p. 86, pl. 28, 1841.
Dendroica aureola SCLATER AND SALVIN, Proc. Zool. Soc. Lond., p. 323, 1870. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 493, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 147, 1899.
Dendroica petechia aureola RIDGWAY, Bull. U. S. Nat. Mus., No. 50, Pt. II, p. 521, 1902.

Range. — Coast of Ecuador and Peru, Cocos and Gorgona Islands and every island of the Galapagos Archipelago.

We found this species generally distributed on all the islands from sea level to the tops of the highest mountains. It was most abundant in the mangrove swamps of Albemarle and Narboro. On March 4 a nest was obtained at Iguana Cove, Albemarle, situated a few feet above the ground in the horizontal fork of a small bush. It contained four slightly incubated eggs. The nest is very compactly made and well shaped. The outside is composed of dead, grayish plant stems, green grass and a considerable quantity of cotton (*Gossypium*). The interior is lined with fine brownish rootlets and a few feathers. The dimensions are as follows: height 55, diameter 10, depth of cavity 33, diameter of interior 45.

The eggs are broadly oval in shape, resembling those of *Helmitherus vermivorus*, which they equal in size. The ground color of two of the specimens is light buff; this is heavily spotted and blotched, chiefly in the form of a wreath about the larger end, with umber, chestnut, lavender gray and black. The other specimen (one was broken) is more finely spotted with the same colors on a creamy white ground. They all measure 17 x 14.

MEASUREMENTS OF ADULT SPECIMENS OF *Dendroica petechia aureola*.

Cat. No. Stan Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4200	Albemarle.	♂	144	67	52	12.5	9.3	21
4070	"	"	142	69	54.5	12.5	8.5	20.5
3970	"	♀	140	62	51	13	9.3	20
4053	"	"	135	63	49	12.3	9	21
4148	"	"	144	66	54	12.3	9	20.5
4305	"	"	142	63	49	12.5	8.7	20
4329	"	"	126	64	50	12.5	9	20
3869	Wenman.	"	132	63	48	12.5	8.7	20.5
3868	"	♂	136	67	52	12.7	9.3	20.7
4088	Narboro.	"	148	67	55	12	9	21
3920	"	"	145	66	50	12.5	9	20
3904	"	♀	144	64	51	13	9	20.5
4487	James.	♂	133	66	49	13	9.5	21.5
4560	"	"	137	65	50	12.5	9	21
4637	Seymour.	"	136	64	48	13	9.3	20.5
4736	Charles.	"	146	63	48	12	9	20
4765	Chatham.	"	153	68	54	12	9	21
5084	Bindloe.	"	145	62	50	12.5	9	21

Another nest was found on June 27 near Tagus Cove, Albemarle. This nest contained two incubated eggs, only one of which was preserved. The nest was situated on a horizontal limb of a mangrove tree (*Avicennia*) about twelve feet above the water of the swamp.

It is more solidly constructed than the last, being composed outwardly of closely woven plant fibers, stems, cotton and egg cocoons of spiders. The interior is deep and lined with fine grass, and feathers of the Galapagos duck (*Pœcilonetta*).

The one egg preserved is much like those of the other set in shape and coloration. It has a creamy ground color and is blotched, mostly in the form of a wreath about the larger end with chestnut, umber and lavender-gray. The specimen measures 17 x 14.

The notes of this bird are much like those of any other *Dendroica.* One common song resembled *tū-weé*, *tū-weé*, *tū-weé-ū*, uttered rather rapidly. Another sounded like *tūl-twee-twee-twee.* The first syllable of this was somewhat prolonged and separated from the second by a space greater than that between the others.

We have eighteen adult specimens of this species from Albemarle, Narboro, James, Seymour, Charles, Chatham, Bindloe and Wenman. We observed it on all the other islands except Jervis which we did not visit.

Family TROGLODYTIDÆ.

Genus **Nesomimus** Ridgway.

Nesomimus Ridgway, Proc. U. S. Nat. Mus., xii, p. 102, 1890, footnote. (*Type, Orpheus melanotis* Gould.)

Generic Characters. — (From Ridgway.) "Similar to *Mimus* Boie, but bill longer and more compressed basally, and tarsus much longer (nearly twice as long as middle toe instead of only about one third longer)."

Whether these characters may be considered sufficient for generic distinction or not, the group is certainly a natural one and it is most convenient to recognize it as such by a generic name.

Nesomimus is peculiar to the Galapagos Archipelago where it has been taken on every island except Duncan. It is now apparently extinct on Charles, but specimens were taken on this island by Darwin.

76. NESOMIMUS TRIFASCIATUS (Gould).

Orpheus trifasciatus Gould, Proc. Zool. Soc. Lond., p. 27, 1837 (Charles Island).
Mimus trifasciatus Gray, Zool. Voy. Beagle, iii, Birds, p. 62, pl. 16, 1841 (Charles Island).
Nesomimus trifasciatus Ridgway, Proc. U. S. Nat. Mus., xix, p. 483, 1896. — Rothschild and Hartert, Novit. Zool., vi, p. 143, 1899 (Gardner Island, near Charles).

Range. — Gardner (near Charles). Extinct on Charles.

This species was taken on Charles by Darwin, but has not been seen by any subsequent collectors on this island. It was taken on the small Gardner Island, near Charles, by the Harris expedition in 1897.

Rothschild and Hartert give the following description of *N. trifasciatus:* "This species is easily recognizable by its large size and broad blackish-brown band across the chest, interrupted and concealed in the middle. There are, however, not two bands, as one might expect from Ridgway's 'key.' The wing coverts have very conspicuous large white spots. The wing of the male is 128–130 mm. long, the tail 123 (about — most specimens being in worn plumage with the tails much abraded), tarsus 40, exposed culmen 26–27 mm. The same measurements in the *female* are: Wing 116–120, tail 115 (approximately), culmen 25–26, tarsus 38–40 mm. 'Iris seal-brown, tarsi, feet and bill blackish.'" (Novit. Zool., VI, p. 143, 1899.)

We obtained no specimens of this species, but we did not visit the Gardner Island in the neighborhood of Charles.

77. NESOMIMUS MACDONALDI Ridgway.

Nesomimus macdonaldi RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 103, 1890, fig. 1 (Hood Island), and XIX, p. 484, 1896. — ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 143, 1899.

Range. — Hood and the neighboring Gardner Island.

This species departs widely from all the other species of *Nesomimus* in the great size and curvature of the bill. The culmen varies from 33 to 37 in length, an excess of 6 over the culmen of *N. trifasciatus*. Otherwise its closest relationship is with this species on account of the brownish-buff band that crosses the breast. It is also related to *N. adamsi* of Chatham through the spots on the sides of the breast, and, in fact, stands intermediate between *N. trifasciatus* and *N. adamsi*.

Description of a Typical Specimen. — (No. 5308, adult male, Leland Stanford Jr. University Museum. Hood, May 15, 1899.) Above dusky brown and brownish-gray, the former color occupying the central areas of the feathers, the latter the margins; palest on the rump where the dark central areas of the feathers are the least prominent. Wings and tail blackish-brown, the quills narrowly edged with buffy grayish, the coverts with wide whitish margins, forming three poorly defined bands across the wing. The rectrices with very indistinct pale areas on the inner margins of the tips of the inner webs. Postocular region of head grayish-buff, continuous with an indistinct superciliary line of the same color. Auriculars blackish anteriorly, buffy posteriorly. Lores black. An indistinct blackish subocular line from the lores and a similar maxillary stripe on the side of the throat, inclosing a buffy space between them. Sides of neck buffy. Lower parts buffy whitish, tinged with brownish across the breast, with a few brown spots on the sides of the breast, and darker brown spots along the sides of the abdomen and on the flanks. Under tail coverts whitish, under wing coverts whitish with dark brown centers. Under surface of primaries, secondaries and rectrices paler than above, the primaries and secondaries fading into buffy gray on their inner margins.

Female. — Like the male.

Immature. — Similar to the adults, but whiter below and thickly spotted across the breast; under tail coverts buffy; wing coverts and tertials widely bordered with bright buff and white; terminal spots on rectrices larger, paler and much more conspicuous.

We found the species abundant in May about Gardner Bay on Hood and on the adjoining Gardner Island. The Gardner Island on which *N. trifasciatus* was taken by the Harris expedition is another island of the same name lying near Charles. Our collection contains five adult males, five adult females and several immature birds of both sexes.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus macdonaldi*.

Cat. No Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4882	Hood.	♂	280	120	108	34.5	24	38
4832	"	"	274	123	107	34	23.5	39
4900	"	"	280	123	145	36.5	25.5	40
4888	"	"	280	124	110	35	24.5	40
5308	"	"	280	123	111	35	26	39
4872	"	♀	250	108	97	33.5	21	38
4816	"	"	275	115	105	34	23.5	38
4813	"	"	256	112	107	33.5	23	37.5
4808	"	"	260	110	102	33	21	39
4826	"	"	262	112	100	33	22.5	38

78. NESOMIMUS ADAMSI Ridgway.

Nesomimus adamsi RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 358, 1894 (Chatham Island); Proc. U. S. Nat. Mus., XIX, p. 485, 1896.— ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 145, 1899.

Range. — Chatham.

Description of a Typical Adult.— Back and scapulars light brown, in some specimens almost rusty brown, the feathers with darker centers. Rump paler brownish, with indistinct darker central areas to the feathers. Feathers of top of head with wide grayish-brown margins, narrow, elongate, dusky central parts. Hind neck with a light brownish-gray collar. A pale supraorbital stripe of the same color as the nuchal collar reaching to the latter from back of the nostril.

Lesser and middle wing coverts light brown with pale brownish-gray edgings. Greater wing coverts darker brown with narrow buffy edgings and wider ashy tips. Primaries dusky brown with narrow edgings of pale grayish-brown ;tips with slightly wider edgings of ashy. Secondaries lighter brown with narrow pale brown edgings.

Tail dusky brown, feathers with very narrow pale brownish borders, ashy toward the bases. Under surface of feathers paler, slaty. All the rectrices except the middle pair with a terminal spot of white on the inner web; spots of outermost feathers largest, about twenty millimeters in length, decreasing successively in size on the other feathers toward the middle; spots of feathers next the middle pair always very small, gone entirely when these feathers are much worn.

Lores, suborbital and auricular regions brownish-black. A white line just below edge of under eyelid. A narrow dusky malar stripe. Entire under parts dull whitish. Sides and flanks with dark brown streaks. Sides of lower breast with a few rather large spots of brown on the centers of the feathers; these spots rounded in outline behind, emarginate anteriorly. A slight brownish tone on feathers of lower part of breast, forming an indistinct band connecting the spotted areas of each side.

In coloration, especially in the presence of the spots of the sides of the breast, this form resembles the Hood race *N. macdonaldi* more than it does any other. The spots in the Chatham form, however, are not invariably present; in one specimen that we have they are entirely absent. The species is separated specifically from *N. macdonaldi* by the smaller size of the bill.

This species is very closely related also to the form inhabiting Indefatigable, but is always distinguishable from the latter by the presence of the maxillary stripes. In the color of the back *N. adamsi* is paler than any other form of *Nesomimus* on the archipelago, but in this respect it intergrades with *N. melanotis dierythrus*. It is intermediate between the forms having spotted breasts and those whose breasts are plain, and thus has given rise to two lines of differentiation. Along one line the dark maxillary stripes have been retained and the back has taken on a dusky rather than a brown tone; along the other the brown tone of the back has been retained but the maxillary stripes are lost. The first branch includes the races inhabiting Tower, Abingdon, Bindloe and Culpepper; the second those races inhabiting Indefatigable, Barrington, Wenman, James, Albemarle and Narboro.

We have four adult specimens from Chatham taken May 23.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus adamsi.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4854	Chatham.	♂	240	111	105	25	17	37
4858	"	"	254	114	104	25.7	18	36.5
4806	"	"	253	111	105	25	17.5	39
5705	"	♀		102	93	23.5	16.5	36
Average.			249	109	102	24.8	17.5	37.6

79. THE NESOMIMUS PERSONATUS SERIES.

Rothschild and Hartert have grouped all the forms of *Nesomimus* except *N. trifasciatus*, *N. macdonaldi* and *N. adamsi* under one species *N. melanotis*. We think, however, that two groups instead of one can be distinguished, of which one, *N. personatus*, inhabits the more northern islands of the archipelago — Tower, Abingdon, Bindloe and Culpepper; while the other, *N. melanotis*, inhabits the central islands — Barrington, Indefatigable, Jervis, James, Albemarle and Narboro, and also Wenman, lying to the north.

The differences between *N. personatus* and *N. melanotis* are slight, but the former is characterized by a blackish tone to the central areas of the feathers rather than a brownish. In some cases the general shade of the upper parts in *N. personatus* may be even lighter than in *N. melanotis*, but the light color is due to the marginal areas of the feathers, the central parts in such cases being blackish.

N. personatus is represented by a different subspecies on each island where it occurs. Of these the one on Abingdon was described first and hence must give its name to the group. The Tower subspecies, however, resembles the Chatham species, *N. adamsi*, more than does any of the others, so with it we begin the species.

79*a*. NESOMIMUS PERSONATUS BAURI (Ridgway).

Nesomimus bauri RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 357, 1894 (Tower Island); Proc. U. S. Nat. Mus., XIX, p. 492, 1896.

Nesomimus melanotis bauri ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 145, 1899.

Range. — Tower.

This species has been regarded by Rothschild and Hartert as a subspecies of *N. melanotis.* It cannot, however, be made a variety of this form because all the specimens possess well developed black maxillary stripes, a character not recorded on any specimen from James or Albemarle. The same character relates the form to *N. adamsi* of Chatham but it is separable from this species by the color of the back and by the slightly longer bill.

N. bauri differs from *N. adamsi* as follows: color of central parts of feathers of head blackish rather than brown, edges of some feathers grayish rather than brownish; central areas of feathers of back dusky brown instead of reddish-brown; wing and tail feathers decidedly more blackish and the pale edgings of the same wider and whiter; lores, suborbital and auricular regions black instead of brownish-dusky; sides of lower part of breast distinctly clouded with buff but not forming an entire band across the breast; no spots on the breast in any adult specimens.

In the collection are seven adult specimens from Tower, taken June, 1899.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus personatus bauri.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5217	Tower.	♂	277	118	116	28	19.7	35.3
5263	"	♀	262	110	108	28	20	35
5119	"	"	256	104	100	28	20	34.7
5049	"	"	247	110	98	26.3	20	34.5
5198	"	"	263	109	110	27.7	19.5	35.3
5253	"	"	260	109.5	110	28	20	33.5
5162	"	"	245	110	102	27	18.7	34
Averages.			258	110	106	27.5	20	34.6

79*b*. NESOMIMUS PERSONATUS PERSONATUS (Ridgway).

Nesomimus personatus RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 104, 1890 (Abingdon Island); Proc. U. S. Nat. Mus., XIX, p. 488, 1896.

Nesomimus melanotis personatus ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 144, 1899.

Range. — Abingdon.

This form intergrades through the next — *N. personatus bindloei*— with *N. personatus bauri* of Tower. It is probable, however, that the order of derivation has been the other way, *i. e.*, that the Abingdon form has been derived from the Tower race, for the latter is intermediate between it and the Chatham species. Hence, if the Abingdon form were named according to its zoölogical relationship it would be called "*Nesomimus bauri personatus*"; but, since the Abingdon race was described first, the names, according to the present canons of nomenclature, must stand as given above.

Color of upper parts still darker than in the Tower race, the blackish color of the head pervading also on the back, the whole dorsum being very dark and the lighter margins of the feathers inconspicuous. The nuchal collar is well marked only on the sides of the neck; across the nape it is almost obsolete. The sides of the breast are strongly shaded with buff as in the Tower form. A faint trace of a dark maxillary stripe is present in several specimens.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus personatus personatus.*

Cat. No. Stan Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4973	Abingdon.	♂	265	110	107	26.5	18.7	36.5
5059	"	"		108	104	26.5	18.7	36.5
5277	"	♀	244	110	110	26	18	34
5055	"	"	246	101	96	24	17.3	36.5
5227	"	"	256	109	102	26.5	18.7	37
5114	"		252	98	96	26	19.3	34.5
Averages.			253	;105	102	26	18.4	36

The color of the back of the Abingdon specimens does not directly grade into that of the Tower specimens, but it does do so through those from Bindloe. The latter, however, lack all traces of the maxillary stripe. The bills of the Tower specimens average slightly larger than those from Abingdon, while the latter have bills a little larger than those of the Bindloe specimens. The bills of the Bindloe and Tower specimens intergrade in length only through the Abingdon specimens. Since these different sets of characters do not grade in the same direction, it is perhaps most probable that the Abingdon and the Bindloe races have been derived separately from the Tower form, yet they all intergrade in such a manner that we cannot name them as distinct species, although both the Abingdon and the Bindloe forms have characters that do not directly grade into those of the

Tower birds; from which we assume that they are independently derived. Actually they should probably be regarded as *species;* according to A. O. U. rules of nomenclature as *varieties.*

We have one adult male and three adult females of this subspecies, taken on Abingdon in June.

79*c*. NESOMIMUS PERSONATUS BINDLOEI (Ridgway).

Nesomimus bindloei RIDGWAY, Proc. U. S. Nat. Mus., XVII, p. 358, 1894 (Bindloe Island); Proc. U. S. Nat. Mus., XIX, p. 492, 1896.
Nesomimus melanotis bindloei ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 146, 1899.

Range.—Bindloe.

In the color of the back this form is intermediate between *N. p. personatus* of Abingdon and *N. p. bauri* of Tower. The central areas of the feathers of the head and back have the same blackish tone, but the pale edgings are wider than on the Abingdon specimens though not so wide as on those from Tower. The intensity of the nuchal collar is likewise intermediate between those of the other two forms. None of the specimens has any trace of a maxillary stripe, but this mark is absent on one of the Tower specimens.

The collection contains three adult males and three adult females from Bindloe taken in June.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus personatus bindloei.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5124	Bindloe.	♂	247	103	101	24	17	34
4919	"	"	246	106	102	25	17.5	34.5
5186	"	"	248	107	102	24	17	35
5144	"	♀	232	102	100	23	16.5	33.5
5143	"	"	240	99	96	23.5	16.5	35
5156	"	"	240	101	103	23	16.5	34
Averages.			242	103	102	23.7	16.7	34

79*d*. NESOMIMUS PERSONATUS HULLI (Rothschild).

Nesomimus hulli ROTHSCHILD, Bull. Brit. Ornith. Club, p. 52, May, 1898.
Nesomimus melanotis hulli ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 145, 1899.

Range.—Culpepper.

This form is scarcely distinguishable in color from *N. personatus bauri* of Tower. The specimens average slightly darker in color of the back than do the Tower specimens and the maxillary stripe is somewhat more strongly developed. The bill, however, is considerably shorter, averaging in our Culpepper specimens, 26 and in the Tower specimens 27.5 millimeters in length. The measurements, however, in the two cases overlap, so that we can separate the Culpepper form only subspecifically from the Tower race.

Rothschild and Hartert make the Culpepper form a variety of *N. melanotis*. It differs, however, specifically from true varieties of *N. melanotis* in the blackish color of the back and the presence of the dark maxillary stripes.

The collection contains three adult males and two adult females taken on Culpepper in December.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus personatus hulli*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5311	Culpepper.	♂		108	98	27	19	35.5
5308	"	"		112	110	26.5	19.3	34
5310	"	"	250	113	110	26	19	35
5307	"	♀		105	98	25	18.5	34.5
5309	"	"	230	106	100	26.5	19.3	33.5
Averages.			240	109	103	26	19	34.5

From the preceding descriptions it will be seen that the mockingbirds inhabiting the most northern islands of the archipelago, with the exception of Wenman, viz. Tower, Culpepper, Abingdon and Bindloe, are interrelated to one another in such a manner that they form four varieties of one species. They are all characterized by a melanistic tone to the feathers of the head and generally of the back, being thus distinguishable from those forms inhabiting the central and southern islands of the archipelago, which have a brownish tone pervading the upper parts. These northern forms must be named as varieties of the Abingdon race *N. personatus*, because this was the first one described; but their relationship is probably severally with the Tower race, *N. personatus hulli*, since this one most resembles the Chatham race to which the melanistic forms are probably related on account of the retention by most of them of the dark maxillary stripes, but from which they are specifically separated by the color of the top of the head and the back.

80. THE NESOMIMUS MELANOTIS SERIES.

This group, as already stated, differs from the last, *N. personatus*, in having the central areas of the feathers of the back distinctly brown and not blackish. It inhabits Barrington, Indefatigable, Jervis, James, Albemarle, Narboro and Wenman. It has probably been separately derived from *N. adamsi* of Chatham. It comprises four subspecies. We describe these in the order of their apparent relationships, rather than according to priority of names. The name *melanotis* was first given to specimens of this species from James.

80*a*. NESOMIMUS MELANOTIS DIERYTHRUS Heller and Snodgrass.

Nesomimus melanotis (in part) GOULD, Voy. Beagle, III, Birds, p. 62, 1841. — RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 489, 1896.
Nesomimus melanotis melanotis (in part) ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 145, 1899.
Nesomimus melanotis dierythrus HELLER AND SNODGRASS, The Condor, Vol. III, No. 3, May, 1901 (Indefatigable and Seymour Islands).

Range. — Indefatigable and the Seymours.

This form presents the first departure from the Chatham race along a line differing from that of the melanistic northern species, *N. personatus*, in the retention of the brown color of the upper parts of the Chatham species, and in the loss, from the beginning, of the dark maxillary stripes.

Subspecific Characters. — Very similar to *N. adamsi* of Chatham, differing from it specifically in never possessing any trace of maxillary stripes. Color of the back brown, averaging darker than on Chatham specimens; lores and auricular region blacker; never any spots on sides of breast; culmen averaging slightly shorter.

If Chatham specimens should be obtained not possessing maxillary stripes, then it and the Indefatigable form could not be specifically separated and the Chatham variety would have to be named *N. melanotis adamsi*, since *melanotis* was the first name given to any of the brown-backed forms. Although the color of the back intergrades between the two forms, yet that of the Indefatigable and Seymour specimens averages distinctly darker, lacking the almost rusty tone present on the Chatham specimens.

The collection contains two adult males and two adult females from Indefatigable Island, taken on the part adjoining the Seymour Islands, three adult males and one adult female from the northern Seymour Island, and three adult males and three adult females from the southern Seymour Island, besides several immature specimens; all taken during the last of April and the first of May.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus melanotis dierythrus*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril	Tarsus.
4680	Indefatigable.	♂	241	103	101	23.5	16.5	35
4694	"	"	250	108	103	23.7	17	35.5
4664	"	♀	238	95	93	23	15	34
4693	"	"	243	103	103	22	15.5	34
4659	"			97	90	23	16	34
4587	North Seymour.	♂	238	110	106	22.7	16	36.5
4565	"	"	240	109	106	23.5	17	35.5
4568	"	"	242	113	108	23	16	34.7
4566	"	♀	229	102	107	22	16	34
4563	"			110	113	23.5	15.5	36
4620	South Seymour.	♂	244	109	103	23.5	17	36
4621	"	"	246	107	102	22.5	16.5	36
4635	"	"	228	104	95	22.5	15.5	35.5
4612	"	♀	238	104	96	21.5	15	34
4629	"	"	232	103	94	22	15	34
4646	"	"	240	103	95	23	15.5	35
Averages.			239	105	94	22.6	16	35

80*b*. NESOMIMUS MELANOTIS BARRINGTONI (Rothschild).

Nesomimus carringtoni ROTHSCHILD, Bull. Brit. Ornith. Club, Oct., p. 52, 1898 (Barrington Island.) (Name a misprint for *barringtoni*.)

Nesomimus melanotis carringtoni ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 145, 1899.

Nesomimus melanotis melanotis ROTHSCHILD AND HARTERT (in part), Novit. Zool., VI, p. 145, 1899 (Wenman).

Range. — Barrington and Wenman.

The *Nesomimus* of Barrington was separated by Rothschild from the James *N. melanotis* on the "longer and slenderer bill, shorter wing and generally paler upper surface." These characters hold in our specimens. The race is, however, rather related to the Indefatigable form than to the James race, resembling the former in the color of the head and back and differing from it in the greater length of the culmen, the length of the culmen in *N. m. barringtoni* averaging about 22.6 in length.

Rothschild and Hartert assign the *Nesomimus* of Wenman to the same variety as the James form, *N. melanotis melanotis*. Our specimens, however, are identical in every way with the Barrington Island specimens.

It is rather curious that the *Nesomimus* of this island so far to the north should be related to forms of the central islands rather than to those of the neighboring islands, Culpepper and Abingdon.

We have five adult males from Barrington taken in May, and two adult males and two adult females from Wenman taken in December.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus melanotis barringtoni*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
3862	Wenman.	♂	240	109	109	26	19	34
3861	"	"	230	109	109	25.3	18	34
3858	"	♀	221	102	101	24.5	18.3	32.5
3860	"	"	215	102	95	24.7	17	33
Averages.			226	105	100	25	18	33.4
4961	Barrington.	♂	240	104	102	25	18	32
4935	"	"	245	109	104	25.5	18.5	34
4966	"	"	257	103	106	26	18	34
4909	"	"	233	108	87	26	19	33
4974	"	"	254	110	99	27.5	20.3	35
Averages.			246	107	100	26	18.6	33.6

80*c*. NESOMIMUS MELANOTIS MELANOTIS (Gould).

Orpheus melanotis GOULD, Proc. Zool. Soc. Lond., p. 27, 1837.
Mimus melanotis GOULD, Voy. Beagle, III, Birds, p. 62, 1841 (Chatham and James Islands). — SALVIN, Trans. Zool. Soc., IX, p. 471, 1876 (Charles ?, James and Indefatigable Islands).
Nesomimus melanotis RIDGWAY, Proc. U. S. Nat. Mus., XIX, p. 489, 1896.
Nesomimus melanotis melanotis ROTHSCHILD AND HARTERT (in part), Novit. Zool., VI, p. 145, 1899 (James, Jervis).

Range. — James (and Jervis ?).

This form is very close to the Indefatigable race, but is separable from it as a variety by the darker tone of coloration on the head and back, and by the longer bill — the culmen of our specimens from James averaging 24.6 while that of the Indefatigable and Seymour specimens averages only 22.6.

The collection contains four adult males, four adult females, and numerous immature specimens taken on James in April.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus melanotis melanotis*.

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
4514	James.	♂	242	108	106	25	17.5	37
4546	"	"	253	113	113	24	18	36
4600	"	"	250	110	108	25	18.3	36
4572	"	"		113	111	25.7	18	38
4472	"	♀	253	110	105	26	19	37
4606	"	"	248	106	106	23.5	16.5	35
4557	"	"	242	106	108	23	16.3	36
Averages.			248	109	108	24.6	17.6	36.4

80*d*. NESOMIMUS MELANOTIS PARVULUS (Gould).

Orpheus parvulus GOULD, Proc. Zool. Soc. Lond., p. 27, 1837.
Mimus parvulus GOULD, Voy. Beagle, III, Birds, p. 63 1841 (Albemarle Island). — SALVIN, Trans. Zool. Soc., IX, p. 472, 1876. — SHARPE, Cat. Birds Brit. Mus., VI, p. 350, 1881.
Nesomimus parvulus RIDGWAY, Proc. U. S. Nat. Mus., XII, p. 102, 1889.
Nesomimus parvulus parvulus ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 146, 1899.
Nesomimus affinis ROTHSCHILD, Bull. Brit. Ornith. Club, p. 53, 1898.
Nesomimus parvulus affinis ROTHSCHILD AND HARTERT, Novit. Zool., VI, p. 146, 1899.

Range. — Albemarle and Narboro.

We have a large series of *Nesomimus* from Tagus Cove, Elizabeth Bay and Iguana Cove on Albemarle and from the north and east sides of Narboro, and we cannot discover any character separating the specimens from the two islands into two varieties. Rothschild and Hartert have described the Narboro birds as a subspecies of "*N. parvulus.*"

This variety is most closely related to *N. m. melanotis* of James, from which it is distinguishable by the general smaller size, specially smaller bill and darker coloration of the upper parts. All the characters, however, completely intergrade, so that the form cannot be retained as a separate species.

It is evident that the line of development from the Chatham form has been through the Indefatigable form to the James and from the latter to the Albemarle-Narboro form, for all of these are linearly related to one another in the order given. The general tendency has been toward a darkening of the color of the upper parts. The Chatham specimens have the lightest shade to the feathers of the top of the head and the back, and those of Albemarle and Narboro the darkest.

MEASUREMENTS OF ADULT SPECIMENS OF *Nesomimus melanotis parvulus.*

Cat. No. Stan. Univ. Mus.	Locality.	Sex.	Length.	Wing.	Tail.	Culmen.	Maxilla from Nostril.	Tarsus.
5258	Albemarle, Tagus Cove.	♂	243	115	103	22.5	15	34.5
4114	" " "	"	238	113	113	21.5	15	35.5
4010	" " "	"	240	109	111	21	15	37
4212	" " "	"	236	106	108	23	16.7	35
4375	" " "	"	243	108	104	22	15	34.5
4038	" " "	♀	228	98	105	22	15	34.7
4025	" " "	"	221	96	100	21.5	15	33.5
3936	" " "	"	230	105	107	21.3	14	37
3979	" " "	"	228	101	104	21	14.3	34
3932	" " "	"	232	99	108	22.5	15	33
4231	" " "	"	240	102	110	22	15	35
4100	" Iguana Cove.	♂	220	106	106	20.5	14	37
3959	" " "	"	230	108	108	21.7	16.3	
3964	" " "	♀	225	99	101	21	14.3	35
4221	" Elizabeth Bay.	♂	230	111	111	21	15	35.5
4306	" " "	"	245	105	114	21.7	15	37
4253	" " "	"	238	110	105	21	15	36.5
4284	" " "	"	231	107	105	21	14	35.5
4307	" " "	"	240	109	108	20.5	15	37
4300	" " "	"	245	115	105	22.5	16	36
4256	" " "	♀	226	102	98	21	14.5	35
4254	" " "	"	235	109	118	21	15	36
4229	" " "	"	222	99	104	21	15	36.5
4252	" " "	"	238	103	105	21	15	34.5
4227	" " "	"	232	104	106	22	15.3	36.5
Averages.			230	105	107	21.5	15.3	35.6
4430	East side of Narboro.	♂	245	109	105	22.5	14.7	36.5
4165	" "	"	246	111	109	22	14.7	35
4131	" "	"	235	111	114	22	16	33.5
4126	" "	"	248	111	117	23	16	38
4137	" "	"	226	107	113	22	16	36.5
4143	" "	♀	233	102	100	22	15.5	34
4172	" "	"	235	101	104	22	14.3	36.5
4156	" "	"	226	100	98	21.7	14.7	35
3999	North side of "	♂	248	109	117	22.3	15	36
3990	" "	"	232	109	111	22.5	15.7	35
3969	" "	♀	222	102	103	22	16	35.5
3928	" "	"	242	107	108	22	16	35
3967	" "	"	231	100	107	23.5	15	35.5
4044	" "	"	220	98	100	22	15	35
4502	" "	"	235	97	102	21	14.7	33
Averages.			235	105	107	22.2	15.2	35

Some of the Narboro specimens are so dark that the color can scarcely be distinguished from that of the Bindloe birds. The bills of the Bindloe specimens also are of the same size as those of the Albemarle and Narboro specimens, and specimens may be selected from each set having almost no distinguishing mark whatever between them. This is very evidently a case of convergent evolution, for the general tone of coloration of the upper parts of the Albemarle-Narboro birds is brown, resembling that of the James and Indefatigable specimens, while that of the Bindloe specimens is dusky, resembling that of the Abingdon, Tower and Culpepper specimens.

The collection contains five adult males and six adult females taken at Tagus Cove, Albemarle, during January and March; two adult males and one adult female taken at Iguana Cove, Albemarle, the last of December; six adult males and five adult females taken at Elizabeth Bay, Albemarle, in February; and seven adult males and eight adult females from the east and north sides of Narboro Island in January, March and April. Besides these we have numerous immature birds.

PROCEEDINGS

OF THE

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NOTICES OF DECEASED MEMBERS.

Marcus Baker.

1849–1903.

Marcus Baker, assistant secretary of the Carnegie Institution, died on December 12, 1903. Mr. Baker was born September 23, 1849, and was therefore fifty-four years of age. His childhood was spent on a farm in Michigan and his youth in the city of Kalamazoo. His early education was obtained at the common schools of that city. He attended Kalamazoo College for two years, finishing his college course by two years at the University of Michigan, from which he graduated in 1870. Later in life he attended the law course at Columbian University in Washington and received from that institution the degree of LL.B. in 1896.

His first work after graduating from the University of Michigan was as computer upon the Nautical Almanac. He was afterwards professor of mathematics in Albion College in Michigan for a year and then spent two years as instructor in mathematics in the University of Michigan. In 1873 he received an appointment on the United States Coast and Geodetic Survey, and with that organization he was associated for thirteen years. His work during this period consisted in explorations of the Alaskan coast, in which he was associated with Dr. William H. Dall, in the preparation of the "Alaskan Coast Pilot" and in geographic publications relating to that territory.

In 1882 he was stationed at Los Angeles, California, where he was engaged in the establishment of a first-class magnetic observatory. His last work upon the Coast and Geodetic

Survey consisted in a study of the tides and currents in New York harbor.

In 1886 Mr. Baker resigned from the Coast Survey to accept a position upon the United States Geological Survey and was placed in charge of the northeastern section of topography. After carrying on this work for a time he was made assistant to the director in the preparation of reports and scientific papers, and subsequently was editor of topographic maps. He was for a time detached from the Geological Survey as cartographer of the Venezuelan Commission, and in that capacity accompanied the Commission to Paris where he assisted in the arbitration concerning the Venezuelan boundary.

During the last two years of his life Mr. Baker was assistant secretary of the Carnegie Institution of Washington, although his relations with the Geological Survey had not been entirely broken off.

Besides these, which may be called his regular duties, Mr. Baker was associated with many other works, both scientific and of public improvement. When the Joint Commission of the scientific societies was formed, he was made its secretary, and as such prepared the Joint Directory for several years. He was a member of the board of management of the Washington Academy of Sciences and editor of its publications. He was a director in the Equitable Building Association and in the Washington Sanitary Improvement Company and a member of the Board of Trade. He was, for more than ten years, a member of the Board on Geographic Names and its secretary.

As will be seen from the foregoing schedule of his activities, Mr. Baker was a man of varied attainments and of many lines of interest. His work, in whatever direction it was prosecuted, was thorough, conscientious and faithful, and marked by great ability. In his personal relations he was ever kind, helpful and self-sacrificing, and he leaves behind him many friends in various walks in life.

Mr. Baker was married in 1874 to Miss Sara Eldred who died in 1897. In 1899 he married Miss Marion Una Strong, who, with two children, survives him.

HENRY GANNETT.

Samuel Clagett Busey.

1828-1901.

Samuel Clagett Busey, son of John and Rachel Clagett Busey, was born July 23, 1828, on a farm known as "Stony Lonesome" a few miles west of Washington. His father's ancestors came from Scotland and settled in Maryland in 1754, while the Clagetts arrived from England as early as 1671.

His elementary education he received from his mother, whose early widowhood compelled her, though in feeble health, to personally supervise the management of the farm. She was a refined and cultivated woman possessed of great force of character and energy, qualities which she carefully inculcated in her sons.

From 1841 to 1845, the boy Busey attended the Rockville Academy then in charge of Mr. Wright. In 1844 he was offered an appointment to a cadetship at West Point. This he had greatly coveted, but his mother refused her consent and insisted that he should enter the medical profession. In May, 1845, he began the study of medicine in the office of Dr. Hezekiah Magruder, of Georgetown. The following winter he attended the lectures on Anatomy and Operative Surgery at the National Medical College, but he soon discovered that private teaching with text-books twenty-five years old, was far from satisfactory, and, although the income from his estate was quite inadequate even in those frugal days, he went to Philadelphia in the spring of 1846; here he entered the office of the famous Dr. Geo. B. Wood, and at the same time the University of Pennsylvania, where he enjoyed the teaching of such men as the elder Pepper, Wood, Gerhard, Chapman, Gibson, Homer, Hodge, and graduated April 8, 1848. In May, 1848, he began his lifework in Washington in an office on Capitol Hill; and in the following year he married Miss Catherine Posey. In the struggle for existence, which confronts every beginner in a profession, it must be a source of encouragement to know that so eminent and successful a man as Dr. Busey began at the bottom, earning less than a dollar a day the first year, while the receipts from his second year's practice were only $800.00. Thereafter his practice, his income and his influence steadily increased.

In 1853 he was elected Professor of Materia Medica in the Medical Department of Georgetown University. From 1853 to 1856 he served as a member of the City Council and assisted in editing a political newspaper. Advocating as he did the principles of the so-called "American Party" it may be assumed, that a man of such positive convictions, fearless and outspoken, made many political enemies. In 1858 symptoms of pulmonary disease appeared and drove him to take up the life of a farmer. He moved out to "Belvoir," near the site of what is now Cleveland Park. This change, although in opposition to the views of his friends, was undoubtedly beneficial and added many years to his useful life. During his farm life he attended professionally most of the neighboring families and kept up with the rapid advances then being made in the medical sciences. When after ten years he returned to Washington in September, 1869, he was physically and professionally well equipped for the busy life awaiting him. In that year he helped to organize a dispensary in connection with the Columbia Hospital and was placed in charge of the Department of Diseases of Infancy and Childhood. One of the blessings resulting from this connection was the establishment, November 25, 1870, of the Children's Hospital. In 1872 the staff of the Columbia Hospital and Dispensary established the first Post Graduate School of Clinical Medicine in this country, and he was one of the most successful teachers. In July, 1875, he was appointed Professor of Diseases of Infancy and Childhood in the Medical School of Georgetown University. In 1880 he was one of Dr. Jacobi's coadjutors in establishing the section of diseases of children in the American Medical Association. He presided over the first meeting, read the first paper entitled "Chronic Bright's disease in Children caused by Malaria," and was elected Chairman of the Section in 1881. He was also one of the founders of the American Pediatric Society. His interest in behalf of sick children remained unabated; in 1896–1897 he pointed out the absence in Washington of suitable provisions for the treatment of scarlet fever, diphtheria and the milder contagious diseases. From the lack of these facilities lives were being sacrificed and contagion spread while seeking relief, denied by existing hospitals, because of the ignorant fear that such isolation pavilions might prove centers of infection. Thanks to his persistent efforts, these pavilions have been established in connection with two hospitals and their effect in diminishing the foci of infection is already apparent by a decrease in the prevalence of these diseases.

In 1875 he was elected President of the Medical Association and in 1876, Professor of Theory and Practice of Medicine in the Medical School of Georgetown University, which position he filled until compelled by declining strength to give up active teaching. By his death this school lost a most distinguished teacher, one who in the past was instrumental in promoting its usefulness, advancement and reputation, and one who richly merited and received in 1899 the degree of Doctor of Laws, the highest honor the University had to bestow.

In 1877 he was elected President of the Medical Society and reëlected from 1894 to 1899, a distinction which he esteemed more highly than any other honor that came to him during his professional career, not even the Presidency of the Association of American Physicians, to which exalted position he had been chosen in 1890. Perhaps, he cared only for this distinction, that it might be used as an instrument to promote the scientific progress of the Society and to encourage the profession to assert itself in all matters pertaining to sanitation.

He was also editor of a local medical journal, one of the founders of the Garfield Memorial Hospital, of the Washington Obstetrical Society, Columbia Historical Society and a member of other scientific bodies. In 1898 he was chosen one of the Founders of the Washington Academy of Sciences, and became an active member of its Board of Managers representing the Medical Society as Vice-President until his death.

On the fiftieth anniversary of his graduation in medicine, April 8, 1898, Dr. Busey was tendered a banquet by the local profession. The congratulations extended to him came from many of those who were associated with him in his career in this city, during some portion at least of the fifty years, and it was a source of great comfort to receive in life's evening such evidence of good will and esteem from his professional brethren.

How well he deserved this evidence of respect is shown by a list of more than 165 distinct contributions to medical literature, besides his miscellaneous publications. The world is indebted to him for his work on "Congenital Occlusion and Dilatation of Lymph Channels" and his masterly exposition of "The Wrongs of Craniotomy upon the Living Fœtus," writings which have long since become classic.

Dr. Busey, notwithstanding his natural reserve and austerity, was always the friend and leader of the practitioner in uniformly contending for the rights, honor and dignity of the medical profession, and in his relation to the public, Dr. Busey evidently believed that the education and betterment of the people at large in sanitation are not less humane than the healing of the sick. That he discharged this obligation imposed by the Code of Ethics of the American Medical Association is evidenced by his numerous contributions to preventive medicine, his public addresses, and the fact that he with his colleagues of the Committee on Legislation were instrumental in framing and enacting seven laws in the interest of public health. Indeed the history of sanitation of the National Capitol is inseparably connected with that of the Medical Society and Dr. Busey as its President.

For several years Dr. Busey had been in delicate health, yet his interest in the Academy was so great that he rarely missed a Board meeting and rendered service as Chairman of several prominent committees; he also made the Academy the beneficiary of a bequest, without conditions, amounting to about $5,000.00.

Peacefully and quietly in the earliest morning hours of Feb. 12, 1901, came the end, that end which despite anticipation or expectation, was felt as a shock through a wide circle of friends and admirers in the city which he loved and which owes so much to his bright, fertile and discerning mind.

George M. Kober.

Richard Urquhart Goode.

1858–1903.

In the death of Mr. Richard Urquhart Goode at Rockville, Md., on June 16, 1903, the Washington Academy of Sciences lost a charter member who had always taken a lively interest in its proceedings, and the United States Geological Survey lost one of its most trusted and accomplished division chiefs.

Mr. Goode was born in Bedford, Va., on December 6, 1858. His ancestors were among the more prominent of the early settlers of the United States, the family genealogy dating back to England. His father, Hon. John Goode, for a number of years represented Virginia in Congress, and during the first administration of President Cleveland served with distinction as Solicitor General. Richard Goode's mother was Sallie Urquhart, of Wight County, Va.

Mr. Goode's early education was received at Hanover Academy, Norfolk, Va., after which he attended the University of Virginia for several terms. His first experience in engineering was acquired in 1877 and 1878 as assistant in the Engineer Corps of the Army. In 1879 he received an appointment from the Secretary of the Interior as topographer in the United States Geological Survey, and until 1882 he retained this appointment. During that period he had charge of a party of surveyors engaged in extending topographic surveys through portions of Arizona, Utah and New Mexico. In 1883, on the creation of the Northern Trans-Continental Survey, under the auspices of the Northern Pacific Railway, a large corps of geologists and topographers was engaged under Raphael Pumpelly in an exhaustive study of the natural resources of the region contiguous to the proposed line of railway. On this work Mr. Goode was employed as topographer during a portion of 1884, when he conducted extensive surveys in Montana, Washington and elsewhere in the northwest. In 1884 the United States Geological Survey being in urgent need of the services of skilled engineers, Mr. Goode was induced to return to work with this bureau, and he remained with it until the time of his death, serving in various capacities from topographer to geographer in administrative charge of surveys in the western half the country. In 1888 he was granted leave of absence in order that he might assist the engineers of the Panama Canal Company in important topographic and land surveys covering property rights in the Isthmus of Darien. His duties with that organization were those of engineer and astronomer. In 1889 he was transferred to charge of the southern central division of topography, at which time he was promoted to geographer. In September, 1890, he was transferred to the western branch, and placed in charge of the Kansas-Texas division, which assignment he retained until August, 1894, when he was transferred to the more important charge of the Pacific section. On the reorganization of the topographic branch incidental to the retirement of Messrs. Gannett and Thompson from charge of the eastern and western sections, respectively, Mr. Goode was assigned charge of one of the four sections into which the branch was divided, the Pacific section, which included all of the United States west of the Rocky Mountains, to which was later added surveys in Alaska and forest-reserve boundary surveys.

Mr. Goode was a member of the Washington Academy of Sciences and of the National Geographic Society, and was an officer and prominent member of the Cosmos Club. For several years past he had been a vestryman of St. Margaret's church. In 1889 Mr. Goode was married to Sophie J. Parks of Norfolk, Va., who survives him with three children, the eldest about thirteen and the youngest about nine years of age.

H. M. Wilson.

William Harkness.

1837–1903.

The village of Ecclefechan, near Dumfries, Scotland, has long been known as the birthplace of Thomas Carlyle. Henceforth it must be known also as the birthplace of another rugged Scotsman, Professor William Harkness, who, having come in youth with his parents to the United States, became one of the leading men of science of America and won for himself a position of eminence in the domain of astronomy.

Professor Harkness was a son of Rev. Dr. James and Jane (Weild) Harkness. He was born December 17, 1837; and he died February 28, 1903, at Jersey City, N. J. From his boyhood he was an active student, and had prepared himself, chiefly, when he entered Lafayette College in 1854. On the removal, two years later, of his parents to Rochester, N. Y., he entered Rochester University, graduating thence with the degree of A.B. in 1856.

After leaving college he served as a reporter for the Albany *Atlas and Argus* in the New York Legislature in 1858, and in the Pennsylvania Senate for the Harrisburg *Daily Telegraph* in 1860. In this work he acquired a facility in stenography which was of much service to him in later life. In the meantime he was a student of medicine and took the degree of M.D., after a course of study in New York City, in 1862. August 1 of the latter year he was appointed as an aid on the staff at the U. S. Naval Observatory. The exigencies of the Civil War soon called him from astronomical to military duties and he served as a surgeon at the second battle of Bull Run, August 30, 1862. A year later (August 24 ,1863) he was commissioned professor of mathematics in the navy, but he continued in the militant branch of the service up to 1867, when he was assigned to duty at the Naval Observatory and was able to devote himself chiefly thereafter to astronomical work up to the time of his retirement from active duty in December, 1899. During this interval of thirty-two years, however, he was away from the observatory on several occasions to observe eclipses, and was absent for about a year in charge of an expedition to Tasmania to observe the transit of Venus of 1874.

His long career in the government service was characterized by the most conscientious and indefatigable industry. Into the large projects which were committed to his care, especially those of fitting out the American parties for observing the transits of Venus of 1874 and 1882, and the building and equipping of the new Naval Observatory, he entered with a zeal and a fidelity which taxed often to the verge of exhaustion his strong frame and his vigorous mind. He had a highly developed capacity for mechanical invention, and he devised many instruments and pieces of apparatus noteworthy for their ingenuity and effectiveness. He was an unusually skillful experimentalist, and was thus able to remedy with his own hands many defects of the instruments he employed. His wide experience as an observer of astronomical and other physical phenomena, and his intimate knowledge of ways and means available for securing measurements of precision, made him one of the first authorities of his time in these subjects.

Although his life was especially busy with what may be called the engineering side of astronomy, he found time to prepare many papers, reports and semi-popular scientific addresses. Of these products of his fertile and suggestive mind, it may suffice here to mention the memoir to which he justly attached most importance, namely, that on "The Solar Parallax and Its Related Constants," published in 1891. In this paper he takes the independently observed values of the many constants of the solar system and adjusts them by the method of least squares to conformity with the necessary conditions which exist among them. This was an original and a bold contribution, the merits of which are, perhaps, not yet generally appreciated, but it must surely take rank along with the important advances in astronomy of the nineteenth century.

Professor Harkness was twice vice-president of the section of astronomy and mathematics of The American Association for the Advancement of Science, in 1881 and 1885, and president of the same Association in 1893. He was president of the

Philosophical Society of Washington in 1887. Lafayette College conferred on him the degree of A.M. in 1865. The University of Rochester conferred upon him the degree of A.M. in 1861 and that of LL.D. in 1874. On his retirement in the navy, for age, in 1899, he was promoted to the rank of rear-admiral.

Personally Professor Harkness was a striking figure. Openly frank, always deeply in earnest, he took life very seriously. His frankness was sometimes mistaken for bluntness or rudeness, and being strong in argument on all debatable questions, he seemed occasionally to show little quarter for his opponents. But to those who knew him well he was one of the most genial and kindly of men. Only a few friends were admitted to the privacy of his celibate life. Those who have sat with him in the quiet of his study and have drawn from his store of knowledge and good counsel will remember him as much for his sane and manly friendship as for his conspicuous fidelity in the public service.

R. S. Woodward.

Henry Barker Hill.

1849–1903.

Henry Barker Hill, Professor of Chemistry and Director of the Chemical Laboratory of Harvard College, died April 6, 1903, in the fifty-fourth year of his age, after a brief but painful illness. His death makes an irreparable gap in the ranks of American scientific men.

Professor Hill's life was a quiet one — the life of an investigator in a field of scientific rather than of public interest. His delicate health for years and his retiring disposition prevented many of his colleagues from knowing him well; hence his true worth has perhaps not been fully appreciated by those outside the circle of his intimate friends.

The Rev. Thomas Hill, his father, was at one time President of Antioch College, and later, from 1862 to 1868, President of Harvard University. In 1845 Thomas Hill married Miss Anne Foster Bellows, and on April 27, 1849, Henry Barker Hill was born. Having spent his later school days in Cambridge, he entered Harvard College in 1865 at the age of sixteen years. Here his unusual versatility was soon recognized by his early companions, who felt that with so many possibilities the choice of a profession must be difficult. His mathematical ability was rare; he possessed a keen and sympathetic taste for music, and his literary and philological instincts were strong. When the decision was made, however, there was no swerving or faltering in the path. After graduation in 1869, he went to Berlin, where he studied chemistry for a year with A. W. Hofmann. On returning to America he was made assistant in chemistry in Harvard University, a post which he held for four years. At the age of twenty-five he was promoted to an assistant professorship, and ten years afterwards became full professor.

The always increasing administrative duties of the growing Department of Chemistry were divided on the death of Professor Josiah Parsons Cooke in 1894, and Professor Hill was given the responsibility of the management of the laboratory as director, while Professor Charles Loring Jackson was made chairman of the department. During the nine years of the directorship Professor Hill, with the utmost ingenuity, remodelled and enlarged an old and unsuitable building with such success as to provide available accommodation for over seven hundred men, and to increase immensely the efficiency of the institution. Administrative work of this kind was undertaken with the conscious sacrifice of some of his dearly cherished scientific ideals, but no murmur of complaint escaped him. The long service of thirty-three years to Harvard University was unremitting, for he never claimed the occasional holiday-year which was his due.

On September 2, 1871, he was married to Miss Ellen Grace Shepard, who with their son, Edward Burlingame Hill, survives him. In recent years their summers have been spent in Dublin, New Hampshire, and bicycle rides thence to Cambridge on laboratory business were not unusual occurrences during the summer months.

Besides being a member of the Washington Academy, Professor Hill belonged to a number of other scientific societies. The National Academy of Sciences elected him to membership as long ago as 1883, and he was also a Fellow of the American Academy of Arts and Sciences, and a member of the American and German chemical societies.

Professor Hill's original scientific work was marked by the quality which preëminently characterized his whole life — absolute sincerity. At the outset, great enthusiasm enabled him soon to overcome the handicap of his somewhat inadequate training, and even his first paper on methyluric acid was an unusually thorough and convincing piece of work. Soon afterwards his fortunate discovery of the rare substance furfurol among the products of the dry distillation of wood, enabled him to begin its investigation, and for twenty years his best thought was given to the derivatives of this substance, especially to pyromucic, mucobromic and mucochloric acids. This series of investigations constitutes a remarkably complete and systematic whole, raising a large group of substances from a position of oblivion to one of commanding importance. Later his discovery of nitromalonic aldehyde led him to a number of interesting syntheses of the benzol ring; and last winter he was engaged in the study of derivatives of pyrazol, another ring-structure.

An acute sense of the responsibility of publication was always in his mind; accordingly his words were carefully weighed, and unusually free from misstatements. Work done by students was always repeated with his own hands before publication — instead of being tested only here and there, after the manner of most chemists. His remarkable lectures on organic chemistry were noticeable for the same admirable completeness; they presented a finely balanced and comprehensive view of the subject. In these lectures he occasionally expressed theoretical views of his own which never appeared in print. Many of these views have since been generally adopted at the later independent suggestion of others less diffident about publication. An example in point is his opinion concerning the structure of diazo bodies, first conceived by him over twenty years ago, and now conceded to be the most probable hypothesis.

Hill's original work and his lectures were equally conspicuous for thorough knowledge, convincing logic, and perfect sincerity. Until the end his highly cultivated and widely varied tastes continued to be sources of refreshment and pleasure to him, while to those of his colleagues who came closest he revealed also keen and appreciative sympathy, self-forgetting generosity, a stanch and devoted friendship, undaunted courage, and above all, single-heartedness in the search for truth.

T. W. Richards.

Alpheus Hyatt.

1838–1902.

Alpheus Hyatt was born in Washington, D. C., April 5, 1838, and died in Cambridge, Massachusetts, January 15, 1902.

His school life included a course in the Maryland Military Academy and one year in Yale College. After spending a year in Europe he entered the Lawrence Scientific School of Harvard University, being attracted thither by the fame of Louis Agassiz. Here he graduated in 1862 and immediately enlisted as a lieutenant in the U. S. Volunteer Army from which he was mustered out as a captain in the Forty-seventh Massachusetts Regiment.

After the close of the Civil War, Hyatt returned to Boston and resumed the scientific studies which he pursued with so much vigor and enthusiasm during the rest of his life. Soon afterward he published (*Mem. Bos. Soc. Nat. Hist.*, Vol. I, 1866) his first general paper, "On the parallelism between the different stages of life in the individual and those in the entire group of the Molluscous order Tetrabranchiata," which in the title itself expresses the fundamental idea on which all of his many subsequent discussions of the evolution and classification of the Cephalopoda is based.

In 1867 Hyatt married Miss Ardella Beebe, who with a son and two daughters survives him. In the same year he went to Salem, Mass., where with E. S. Morse, A. S. Packard and F. W. Putnam he took an active part in founding the *American Naturalist* and in organizing the Peabody Academy of Science. His official connection with the Museum work of the Boston Society of Natural History began in 1870, first as Custodian, and afterward as Curator, and continued until his death. He was also for many years professor of zoölogy and paleontology in the Massachusetts Institute of Technology, professor of biology in Boston University, and assistant curator in the Museum of Comparative Zoölogy. From 1888 he gave a considerable part of his time to official work for the U. S. Geological Survey, devoting his attention mainly to lower Mesozoic fossils, and at the time of his death he was completing a monograph on "Pseudoceratites of the Cretaceous" which has since been published by the Geological Survey.

Hyatt's ability and achievements as a biologist were recognized by his election as a member of the National Academy of Sciences in 1875. He held corresponding or honorary membership in many other scientific societies and received the degree of LL.D. from Brown University in 1898.

Hyatt was a specialist and much of his published work was unusually technical, yet he did not allow himself to become narrow in either his interests or his sympathies. While he was able to contribute largely to the philosophical side of biology, he also found time for elementary teaching and popularizing of scientific facts, as shown in the systematic arrangement of the museum under his care, in the direction of the sea-side laboratory at Annisquam, founded by him, and in his direction of the Teacher's School of Science, which successfully prepares the teachers of Boston for their elementary science instruction in the public schools.

Although Hyatt published valuable papers on other classes of animals, such as "Observations on Polyzoa," "Revision of the North American Porifera," and "The genesis of the Tertiary species of Planorbis at Steinheim," and also on general paleontological and geological subjects, his most important works whose influence will doubtless be most lasting, treat of fossil Cephalopoda and of the general principles of evolution which he deduced from their study. Among the more prominent of those works may be mentioned: "Fossil Cephalopods of the Museum of Comparative Zoölogy, Embryology"; "Genera of fossil Cephalopods"; "Genesis of the Arietidæ"; "Phylogeny of an acquired characteristic"; the chapter on Cephalopoda in the English edition of "Zittel's Text-book of Paleontology" and the posthumous "Pseudoceratites of the Cretaceous" already mentioned.

Hyatt's views and position as a general biologist can only be indicated here by the statement that he was regarded as one of the founders and leaders of the so-called Neolamarckian school which in recent years has included so many prominent American biologists. He has also been spoken of as the founder of a new school of paleontology, the distinguishing feature of which is the emphasis that is placed on the study of the life history of the individual (ontogeny) as a rational basis of classification (phylogeny).

Professor Hyatt's enthusiasm in his work, his genial disposition, his readiness to receive suggestions or criticisms from any source, as well as to give them freely when they were desired, made him a source of inspiration to all who knew him.

T. W. Stanton.

William Waring Johnston.

1843–1902.

Dr. William Waring Johnston was born in Washington, D. C., December 28, 1843, and died in Atlantic City, New Jersey, on March 21, 1902. He was the eldest son of Dr. Wm. P. Johnston, who came from Savannah, Ga., and settled in Washington in 1840, where for many years he enjoyed a large medical practice and was Professor of Obstetrics in the Medical School of the Columbian University. The mother of Dr. W. W. Johnston was Mary Elizabeth, daughter of Mr. Bernard Hooe, of Virginia.

The early education of young Johnston began at his father's residence, under direction of a private tutor, who prepared him to enter St. James College, near Baltimore, which he did in 1861, at the age of 18 years. Owing to the Civil War this college closed in 1862, and William W. Johnston returned to Washington where he continued his studies under direction of Mr. Charles B. Young, until the autumn of 1863, when he began his medical studies at the University of Pennsylvania. From this institution he obtained his medical degree in March, 1865, and soon afterwards became an interne at the Bellevue Hospital, New York, where he was on duty during the cholera invasion of 1866. Leaving New York, after the expiration of his term of service at Bellevue Hospital, Dr. Johnston went to the University of Edinburgh, where he became the pupil of Dr. John Hughes Bennett, a noted Professor of Clinical Medicine in the Edinburgh Royal Infirmary. From Scotland, Dr. Johnston went to France and finished his medical education in the hospitals of Paris. He returned to Washington in 1868 to begin medical practice, in preparation for which he had now spent five years in study and hospital training.

At once introduced by his distinguished father and bringing with him the latest methods of medical treatment learned in the European hospitals — especially the then new method of treating disease by rest, food and hygiene, rather than by bleeding and drugs, of which he was an early and enthusiastic advocate — he soon acquired a large practice, the onerous duties of which he continued with unremitting care and industry until the end of his life. It was in this work of a learned, skillful and accomplished practitioner of medicine that he acquired his most distinguished eminence. In addition to his remarkable professional ability, which led to his being frequently called upon for advice in difficult cases by his brother-practitioners, he also possessed, in an eminent degree, the power of inspiring his patients with unbounded confidence, thus relieving their anxieties and fears; and by his gentleness and sympathy he always unconsciously secured their affection and esteem. Thus Dr. Johnston possessed all the qualifications to become, what in reality he was — an ideal physician.

Apart from the exacting requirements of a busy practitioner he still found time to contribute to medical literature. The productions of his pen, while never voluminous, comprised something over thirty separate papers of recognized merit. Notable among these were his contributions to *Pepper's System of Practical Medicine* (Vol. II, 1885); Hare's *System of Practical Therapeutics* (Vol. IV, 1897), and Buck's *Reference Handbook of the Medical Sciences* (Vol. III, 1901). These papers related chiefly to diseases of the intestinal tract, a subject in which he had become especially interested, and on which he was a recognized authority. Other papers appear in the *Transactions of the Association of American Physicians* and of other medical and scientific associations to which he belonged.

There is yet another sphere of professional labor in which Dr. Johnston acquired distinguished eminence, namely, that of teaching clinical medicine. His work as a teacher began in 1870, when he was appointed to give laboratory instruction in "Practical Histology and the Use of the Microscope" in the Medical Department of Columbian University. During the succeeding year he was appointed Professor of the Theory and Practice of Medicine in the same institution, a position he continued to fill until his decease in 1902. Besides his didactic lectures at the Medical School he gave weekly clinical lectures in the wards of the Children's Hospital for a period of twenty-seven years, and at the opening of the new Columbian University Hospital in 1898, he began weekly clinics in this institution, which were continued during the college term, until the end of his life. His last lecture was given on March 6, the day on which his fatal illness began, and 15 days before his death on March 21.

Dr. Johnston was not only an able and successful teacher, but also a strenuous advocate of improvement and reform in the general methods of medical education. He especially insisted that the student should devote more time to practical training at the bedside and less to the theoretical teaching of text-books — a reform, the wisdom of which has been demonstrated throughout the civilized world.

As a public-spirited citizen Dr. Johnston had been instrumental in promoting the establishment of the "Children's Hospital" of this city, and was also one of the founders of the "Garfield Memorial Hospital" and served as consulting physician on its medical staff from 1882 until 1897, when he resigned. He was also on the consulting staff of the "Emergency Hospital," the "Washington Asylum Hospital," "Providence Hospital," the "Episcopal Eye and Ear Hospital" and the "Government Hospital for the Insane."

It was however to the Columbian University Hospital that he was most devoted during the last few years of his life, in recognition of which the medical wards of this new hospital are to be known as the "W. W. Johnston Wards."

Finally, in municipal affairs, Dr. Johnston was an earnest advocate of scientific sanitary reform and a promoter of all laudable measures for the prevention of disease in his native city.

A. F. A. King.

Richmond Mayo-Smith.

1854–1901.

Richmond Mayo-Smith was born in Troy, Ohio, February 9, 1854, and died in New York City November 11, 1901. He was graduated at Amherst College, and then studied for two years in the universities of Berlin and Heidelberg, Germany, receiving the degree of Ph.D. for his advanced studies. On his return to the United States he was called in 1877 to Columbia University, where he served as a tutor for one year, and then from 1878 to 1883, was Adjunct Professor of History and Political Science, becoming in 1883 Professor of Political Economy and Social Science, which chair he held until his death. Dr. Mayo-Smith was associated in the work of the census of Massachusetts of 1885, and was a member of the American Economic Association, on many of the committees of which he was active, and he contributed largely to its publications. He was an honorary fellow of the Royal Statistical Society of Great Britain, and in 1890 was chosen to membership in the National Academy of Sciences. Besides being a member of the Board of Editors of the *Political Science Quarterly*, he was the author of "Emigration and Immigration" (New York, 1890), "Statistics and Sociology" (1895) and "Statistics and Economics" (1899).

Marcus Benjamin.

James Cushing Merrill.

1853–1902.

Dr. James Cushing Merrill, a member of the Washington Academy of Sciences, died at his home in Washington, D. C., on October 27, 1902.

Dr. Merrill was born March 26, 1853, at Cambridge, Mass., where, associated with congenial companions, he learned to love the birds and all nature and laid the foundation of a knowledge of ornithology which in later years brought him to prominence in this field of work. His preliminary studies were carried on at Cambridge but later he went to Germany to complete his education in the schools of that country.

In 1874 he graduated in medicine from the University of Pennsylvania and the following year was appointed assistant surgeon in the U. S. Army. On March 13, 1894, he was made Surgeon with the rank of Major. As medical officer he was stationed at various army posts throughout the country, and when unoccupied by official duties was able to make valuable natural history collections. He was an enthusiastic sportsman and the wild surroundings of many of his posts gave him much opportunity for the enjoyment of the pursuit of big game. While stationed at Fort Brown, Texas, from 1876 to 1879, he was able to add very materially to our knowledge of the ornithology of that region, and was the first to record the existence of certain Tamaulipan species within our borders. Among his more noteworthy ornithological papers may be mentioned: "Notes on the Ornithology of Southern Texas," "Notes on the Birds of Fort Klamath, Oregon," and "Notes of the Birds of Fort Sherman, Idaho."

Doctor Merrill was a member of numerous scientific societies and clubs, the more important of which are as follows: American Ornithologists' Union, Washington Academy of Sciences, Boston Society of Natural History, Nuttall Ornithological Club, Linnæan Society of New York, Biological Society of Washington, Association of Military Surgeons, Association of Medical Libraries, Society of Colonial Wars, Boone and Crocket Club and Cosmos Club.

In November, 1892, he was married to Mary Pitt Chase of Maryland. On April 1, 1897 he was appointed Librarian of the Surgeon General's Office at Washington, a position he held until his death. The arduous and confining duties connected with this office must have been doubly trying to a field naturalist, but they were carried on without complaint, and with such conscientious thoroughness and ability that his assistants were proud to be associated with him.

Doctor Merrill was a modest, unassuming gentleman, a well-equipped naturalist, a pleasing writer, and a conscientious surgeon.

In his untimely death the army has lost a worthy officer, his associates a devoted friend and the Academy a valued member.

A. K. Fisher.

William Manuel Mew.

1835–1902.

William Manuel Mew was born in Newport, Isle of Wight, September 25, 1835. His early education was received in the grammar schools and by private tutor until 13 years of age, after which he had no regular schooling. At this age he went to sea and rose rapidly, attaining at the age of 20 the position of a ship's officer in the Merchant Marine service. He made several trips to the Crimea during that war. In 1858 he came to America and became a teacher in the public schools at Warren, Pennsylvania. While thus engaged he studied medicine with a physician at Warren and afterward took a course in medicine at college. In 1861 he raised a company, of which he was made captain, and joined the Seventy-fourth New York Volunteers. Illness caused him to be honorably discharged in 1863. He was then appointed to a position in the office of Secretary Stanton, from which he resigned in 1865, and in the following year he entered the United States Treasury at the head of the Division of Steamboat Navigation. In connection with this work he was sent abroad by the United States Government to a conference to investigate and revise the laws relating to transportation of emigrants, sanitary conditions and life-saving appliances. He resigned from the Treasury in 1869 and began the study of chemistry with Dr. Leonard Gale, chemist to the Smithsonian Institution, in his private laboratory, and later in the Smithsonian laboratory under Professor Henry. In 1873, through the kindly interest of Professor Joseph Henry, who had watched his progress, he was offered a choice of two positions, namely, as chemist in the Department of Agriculture, the other as assistant to Dr. Craig, chemist at the Army Medical Museum. He accepted the latter position and thus began his 29 years of service in the chemical laboratory of that museum. Upon the death of Dr. Craig within two or three years he succeeded to the position vacated, which position he continued to hold until his death. In 1882 Captain Mew received the honorary degree of Doctor of Medicine from Columbian University in consideration of "his general efficiency in medicine and in collateral branches of sciences."

Dr. Mew was elected a member of the Committee of Revision of the U. S. Pharmacopœia in May, 1890, and in 1893 he was made its treasurer. His reports on drug assays were especially valuable, as his long experience in analyses and assays of drugs and chemicals for use in the medical department of the United States Army well qualified him for this work. Dr. Mew was a constant student of all subjects relating to physics, chemistry and medicine. He was a member of the American Chemical Society and of other societies, and a charter member of the Cosmos Club. For a number of years prior to 1891 he was Acting Assistant Surgeon, U. S. A.

After an illness of a little more than two months Dr. Mew died September 19, 1902.

D. S. LAMB.

Charles Mohr.

1824–1901.

Carl Theodor Mohr or Charles Mohr, as he preferred to be known, will be remembered for his many important contributions to natural science. He was born at Esslingen on the Neckar, in Wurttemberg, Germany, December 28, 1824. At an early age he took a deep interest in scientific studies, and embraced every opportunity for extending his knowledge. Soon after his father's death, young Mohr devoted his hours after school to practical work in a chemical factory at Denkendorf, in which his father had been interested. His taste for the sciences was further developed by reading, and his love of nature was awakened by companionship with his great-uncle, a pensioned government forester, whom he frequently joined in his excursions into neighboring forests.

At the age of eighteen Mohr entered the Polytechnic School at Stuttgart, where he became interested in botany. Here he formed the acquaintance of the botanists Hohenacker and Kappler. In 1845 he accompanied Kappler on one of his botanical explorations to Dutch Guiana. Returning to Europe after a protracted illness, Dr. Mohr became chemist for a manufacturing firm in Brunn, Austria. But the political disturbances of 1848 impelled him to leave Europe for the United States, where the remainder of his life, extending over more than fifty years, was passed.

Dr. Mohr brought to America the same enthusiasm that had characterized his work in Europe, and that ever after constituted one of the marked traits of his character. After a short residence in Cincinnati in the employ of a manufacturing chemist, in March, 1849, he joined a party of young men on their way to the newly discovered gold diggings in California. During his long journey across the Plains and Rocky Mountains he again became deeply interested in botanical research, although his efforts were attended with singular misfortune. He was obliged to abandon one valuable collection of plants while crossing the Plains, and after he had given up the search for gold on account of ill health and was on his way to the East again, he was robbed of another at Panama. This last mishap was especially unfortunate, for Dr. Mohr was one of the earliest botanists to explore central California. To him personally the whole venture had serious consequences, for the passage of the Isthmus brought a return of his illness and the permanent impairment of his health. After trying farming in Indiana and the drug business in Louisville, Kentucky, continued illness forced him to go South. Louisville and Mexico both failed to give him the relief he sought; but in 1857 he found a favorable climate in Mobile, Alabama, where he settled and established a prosperous drug business.

His residence at Mobile was of great value to the scientific world, for he found time to study the resources of the region as no one else has done. His published papers are numerous, and much of his work is of great practical value. His botanical researches were extensive and comprised studies of all the indigenous and exotic plants of Alabama. He made a special study of the useful foreign plants acclimated in the Gulf States and published an account of them. In addition to these studies he investigated, in the interest of agriculture, the chemical values of wood ashes, pine straw, and other forest products. He also studied the geology of Alabama from an economic standpoint.

Branching out from botanical and geological work, Dr. Mohr took up the economic study of Southern forests.

He made large collections of commercial wood specimens and forest products which were installed at various State expositions. He contributed largely both to the Jesup wood collection of the American Museum of Natural History, New York City, and to the Arnold Arboretum of Harvard University. He collected and arranged the agricultural, forest and mineral exhibits at the World's Exposition in New Orleans in 1884. He supplied much valuable material concerning the distribution, commercial yield and uses of Southern timber trees, for the special report upon the forests of the United States included in Vol. IX of the Tenth Census.

In 1894 he was appointed an agent in the Division of Forestry, U. S. Department of Agriculture, and subsequently Forest Expert, a position which he held until his death. During this period his forest studies included an investigation of the timber pines of the Southern United States, which was published as Bulletin 13 of the Bureau of Forestry, United States Department of Agriculture (1897). He personally selected and directed in the field the collection of all the Southern commercial timbers mechanically tested by the Department of Agriculture from 1892 to 1898. More recently he completed monographic studies of the Red Cedar, White Cedar, Bald Cypress, and of the most important commercial oaks of the Southern States. His monograph on the Red Cedar was published as Bulletin 31 of the Bureau of Forestry. The remaining monographs are to be published as bulletins of the Bureau of Forestry.

Through all his economic forest investigations Dr. Mohr found time to complete the crowning botanical work of his life, an exhaustive study of the flora of Alabama. This research covered more than forty years, and was recently published both by the State Geological Survey of Alabama and the United States Department of Agriculture, under the title of "Plant Life of Alabama." Fortunately Dr. Mohr was able to revise the proof sheets of this volume, although he was denied the satisfaction of seeing it in completed form before his death — a matter of great regret to him.

In Dr. Mohr a highly scientific spirit was united with broad and liberal thought. His genuine enthusiasm, his great pleasure in rendering assistance to others, his untiring perseverance and singleness of purpose, no less than his sincerity, kindliness and modesty, impressed themselves upon all who knew him.

In his home life Dr. Mohr showed the same affectionate disposition and unselfish devotion. He was married in 1852, and passed the greater part of his subsequent life at Mobile, Alabama; but in March, 1900, he was obliged on account of failing health to take up his residence at Asheville, North Carolina, where he died on July 17, 1901, in his 77th year. He leaves a devoted family consisting of a wife and several grown sons and daughters.

GEORGE B. SUDWORTH.

Proc. Wash. Acad. Sci., February, 1904.

Walter Reed.

1851–1902.

Walter Reed, M.D., LL.D., M.A., major and surgeon, U. S. Army, was born September 13, 1851, in Gloucester County, Virginia, and was the son of the Rev. Lemuel Sutton Reed, a leading Methodist divine of that State. His ancestors came from North Carolina, having been among the earliest settlers of that colony. He gave early evidence of the intellectual brilliancy and earnestness of purpose which distinguished him in later years, and graduated in medicine at the University of Virginia in 1868. He afterwards took the degree of M.D. in Bellevue Medical College, New York City. He served as house surgeon in the Brooklyn City Hospital and the City Hospital on Blackwell's Island, and before the age of 21 was appointed a district physician in New York City. He was also appointed one of the five inspectors of the board of health of the city of Brooklyn at the age of 22. In 1875 he entered the Medical Corps of the Army, and for eighteen years thereafter performed the customary duties of a medical officer at various posts in different parts of the United States and in the field. His military service included fifteen changes of station with four years in Arizona, five in the Department of the Platte, two in the Department of Dakota, three in the South, and three years in the East. He was promoted full surgeon, with the rank of major, December 4, 1893, and at the time of his death was first on the list of majors in the Medical Department of the Army. In the fall of 1890 he was assigned to duty as attending surgeon in Baltimore, Md., which position he held for a year. He promptly embraced this opportunity to make special studies in bacteriology and pathology.

In 1893 Major Reed was placed on duty in Washington as curator of the Army Medical Museum and appointed the professor of bacteriology of the newly organized Army Medical School.

In the ten years subsequent to this date, in the intervals of his routine duties and others which came to him as a medical officer, such as member of examining boards, teaching, investigation of numerous sanitary questions, and making sanitary inspections, he was able, by immense industry, to obtain a position in the scientific world such as comes to few of those who are able to devote a lifetime exclusively to such pursuits.

Of the numerous monographs which show his scientific work during this time, all are creditable; nor do any show marks of carelessness or haste, in spite of the limited time which he had at his disposal.

In 1898, when typhoid fever prevailed so extensively in the camps of the volunteer armies of the United States, Major Reed was put at the head of a commission to study the causation and methods of spread of that disease. This investigation, which covered a period of more than a year, was remarkable for the patience and skill with which a vast number of details were assembled and studied, and it marks a great advance in our knowledge of this widespread disease. Among the points of great value brought out were the importance of the common fly as a carrier of infection in camps, and the frequency with which the contagion of typhoid fever is in camp life spread from man to man by immediate contact with each other or with bedding, tents, and implements which have become infected.

The first work by Major Reed bearing on the causation of yellow fever was in 1899–1900, when he overthrew the claim of the distinguished bacteriologist, Sanarelli, to have discovered the bacillus of yellow fever, by his demonstration that the *Bacillus icteroides* (Sanarelli) was an organism widely disseminated in this country and having no causative relation to that disease. He began the special work with which his name will always be inseparably associated as one of the benefactors of mankind in June, 1900, when he went to Cuba as president of a commission to study the infectious diseases of Cuba, with special reference to yellow fever. His investigations resulted in the demonstration that in yellow fever the specific infectious agent is present in the blood of those suffering from the disease and that the usual, and probably only, method of transmission of the disease is through the bites of mosquitoes of the genus *Stegomyia*. Also that the mosquito cannot transmit the disease immediately after having filled itself with blood from a yellow-fever patient, but that a "period of incubation" of ten days or more is required before it becomes dangerous as an agent for the transmission of the disease.

This demonstration furnished the necessary basis for preventive measures, which have been applied with entire success in the city of Havana. Major Reed's scientific investigations have therefore been of inestimable value to mankind.

Prof. William H. Welch, of Johns Hopkins, said in a letter to the Secretary of War:

"Dr. Reed's researches in yellow fever are by far the most important contributions to science which have ever come from an army surgeon. In my judgment, they are the most valuable contributions to medicine and public hygiene which have ever been made in this country with the exception of the discovery of anæsthesia. They have led and will lead to the saving of untold thousands of lives."

Major Reed's death occurred on November 22, 1902, as a result of an acute attack of appendicitis.

George M. Sternberg.

Miles Rock.

1840–1901.

Miles Rock, born October 10, 1840, at Ephrata, Lancaster County, Pennsylvania, came of humble German stock. He was the youngest but one of nine children. The father was a tailor, a frugal and industrious man who managed to feed and clothe his family until his untimely death, when Miles was left fatherless at five years of age. The child was cared for by one David Shirk, a large-hearted Mennonite farmer, and in that delightful country grew to boyhood, developing a love of nature and a questioning keenness of observation that were to serve him well in later days. He not only saw that the soils on different sides of a ravine on his foster-father's farm were unlike in color, but he asked why, and from that question sprang the desire for knowledge.

At the age of fourteen, he left the farm and walked to Lancaster where he was given work in the shop of a book-seller and began his serious education by devouring Lyell's Principles of Geology. The lad continued his studies, later supporting himself by teaching school. At the outbreak of the Civil War he was a student at Franklin and Marshall College.

He served with the Pennsylvania volunteers throughout the war, and afterwards entered Lehigh University, graduating as one of the three members of the first class, in 1869. He taught mathematics and mineralogy at his alma mater for a year after his graduation.

In 1870, he married Miss Susan Clarkson, and, accompanied by his wife, went to the newly founded observatory at Cordoba, Argentine Republic. Here with William Morris Davis (now Sturgis Hooper professor of geology at Harvard University) he worked for three years, mapping the stars of the southern heavens under the direction of Dr. B. A. Gould.

From 1874 to 1877, Mr. Rock was engaged in the determination of latitude and longitude in the West Indies and Central America for the U. S. Hydrographic Office, and in 1878 carried on similar work for the Wheeler Survey in our western territories. From 1879 to 1883 he was an assistant astronomer at the U. S. Naval Observatory in Washington, and was a member of the expedition that observed the transit of Venus from Santiago in 1882.

At the request of the Guatemalan government, Mr. Rock in 1883 took charge of their commission for the determination of the boundary line, then in dispute, between that country and Mexico. For fifteen years, with occasional respites, as when he represented Guatemala in the congress that met in Washington in 1884, and agreed upon the use of the Greenwich meridian, Mr. Rock devoted himself with successful and exotic energy to surmounting the natural and political obstacles that obstructed the straight path of his duty. His journals of those years are an absorbing narrative of sustained hardship and romantic adventure in the midst of a tropical wilderness of the rarest beauty.

After completing the survey of the boundary and, by his tact and ability, securing to Guatemala rich territory that she had been in danger of losing, Mr. Rock still spent much of his time in the country he had served so well. He was in Guatemala City, preparing to return to the United States, when he was attacked by a brief illness that ended fatally on the 29th of January, 1901. In recognition of his distinguished services he was buried with public honors by the government of Guatemala, and a monument raised to his memory.

It is not given to a much younger man, who knew Mr. Rock only in his later years, to adequately convey the rare personal charm that was the delight of his intimates and made him an inspiration to all who knew and loved him. There was in him a certain boyish ardor that age could not chill nor disappointments quench. He was generous in the highest sense of that word, and gave of his best to those who needed his help. His scrupulous adherence to the high standards that he set for his own conduct never diminished the original warmth of his heart or contracted the flow of his sympathy. He looked naturally upon life with courageous optimism, seeing many things worthy of the doing and finding his truest intellectual pleasure in achievement.

F. L. RANSOME.

Alonzo Blair Richardson.

1852–1903.

The death of Dr. Alonzo Blair Richardson on the night of June 27, 1903, at Washington, D. C., was a profound shock to his wide circle of friends, patients and admirers. So much had been entrusted to him, so much had been done by him, and so important to us all was that experience and skill, which was given with such earnestness and graciousness, that we little apprehended that the spark of life, which had reached but the early part of the fifties and which seemed to burn with new effulgence, would so suddenly go out.

He was born on a farm in Scioto County, Ohio, September 11, 1852, and spent his early days within this environment. This contemplation and close communion of man with nature has given to our republic its greatest characters. He was one of those born to teach and lead and administer. At the early age of sixteen he was the village schoolmaster, and a few years later he took up medicine and graduated from Bellevue Medical College in 1876. The amelioration and betterment of the treatment of the insane became the guiding star in the whole after life of Dr. Richardson. Evidently the status of the insane at the time of Dr. Richardson's graduation in medicine had made a wonderful and lasting impression, and secured what soon proved to be his powerful influence for reform.

On graduation he was appointed assistant in the Athens, Ohio, asylum for the insane, and there, with the coöperation of his superior officer, he soon abolished all mechanical devices of restraint. His greatest work, before coming to Washington as superintendent of the Government Hospital for the Insane, was in originating, planning, and supervising the new Eastern Ohio Hospital for the Insane, located at Massillon, Ohio. This new hospital attracted so general attention and was so favorably commended by all that Dr. Richardson had but shortly been appointed its superintendent when a vacancy occurring by the death of Dr. W. W. Godding at the Government Hospital for the Insane, President McKinley appointed him to fill this office. In the short time that he was in control of the United States Government Hospital for the Insane he instituted and brought about many changes for the betterment of the institution. Through his zeal and perseverance there is now nearing completion an array of properly grouped and constructed buildings for the care, treatment and housing of the insane, which are among the best and most modern in the world.

He was a forcible and clear writer, and many of his essays rank as authoritative. His address was pleasant and earnest, and the lectures to the Georgetown and Columbian University students were models of thoroughness and clearness. His associates had chosen him in the short span of his life to many positions of honor, and at the time of his death he was president of the American Medico-Psychological Association.

James D. Morgan.

John Daniel Runkle.

1822–1902.

John Daniel Runkle was born at Root, N. Y., October 11, 1822, and died at Southwest Harbor, Me., July 8, 1902.

His early years were passed upon the farm and not until he was 25 did he enter the newly-established Lawrence Scientific School of Harvard University. Here he received the degree of Bachelor of Science and the honorary degree of Master of Arts with the first graduating class in 1851.

His work upon the Nautical Almanac had already begun in 1859, and was continued in some form for thirty-five years. In 1852 he contributed to the *Astronomical Journal* papers on the "Elements of Thetis" and the "Elements of Psyche." In 1855 his "New tables for determining the values of coefficients in the perturbative function of planetary motion, which depend upon the ratio of the mean distances," were published as one of the Smithsonian Contributions to Knowledge.

In 1858 Mr. Runkle, with the endorsement of the American Association for the Advancement of Science and other educational bodies, undertook the conduct of the *Mathematical Monthly*. The coöperation of eminent mathematicians was secured and much interest was developed among subscribers. Conditions were, however, unfavorable, and only three volumes were published.

About 1860 Professor William Barton Rogers enlisted the active support of persons interested in scientific education in the establishment at Boston of the Massachusetts Institute of Technology. Mr. Runkle became connected with this undertaking at an early period, and devoted the remainder of his life very largely to its advancement. In October, 1868, he became acting President, in consequence of the impaired health of President Rogers, and from 1870 to 1878 he was President. The combination of general financial distress and other unfavorable conditions made the position of the new school most difficult and often precarious. President Runkle made a brave struggle against heavy odds, and often with but feeble support.

The principal events of the period were the unsuccessful negotiations with Harvard University for a union; the establishment of laboratories of mining engineering and metallurgy; the introduction of shop instruction and the foundation of the School of Mechanic Arts; the development of professional summer schools in the field; the beginnings of an engineering laboratory; the increased efficiency of military instruction and the summer encampment at Philadelphia in 1876; the erection of a gymnasium and the admission of women students.

Resigning as President in 1878, Dr. Runkle spent the next two years in Europe, and in 1880 resumed his professorship of mathematics. As a teacher he found his highest usefulness and most congenial vocation, a vocation to be happily continued for not fewer than twenty-one years. His teaching was characterized by stimulating, luminous, unconventional exposition, by quick, incisive questioning, by warm personal interest in his students, and by a constant substratum of uplifting earnestness and dignity. None of his students could fail to acquire admiring affection; very few could withstand the incentive to work. His personal and official relations with his colleagues of the Corporation and Faculty were also most fortunate.

H. S. Pritchett.

Simon Sterne.

1839–1901.

SIMON STERNE, a non-resident member of the Washington Academy, died in New York City, September 22, 1901. Mr. Sterne was born in Philadelphia, June 23, 1839. In 1859 he graduated from the law department of the University of Pennsylvania, and after admission to the bar in 1860, he entered upon the practice of his profession in New York City. Quite early in his career he became interested in political economy, and in 1863 and 1865 gave lectures upon that subject in the Cooper Union. In 1864 he aided in organizing the American Free-Trade League, and became its secretary. He was also secretary of the Committee of Seventy during its fight against the Tweed régime, and took an active part in securing proper legislation during that period. In 1875 he was made one of the commissioners to devise a plan for the government of cities in the State of New York. In 1895 he was a member of the commission to recommend changes in methods of municipal administration. In 1896 he visited Europe to report on the relations between governments and railroads. His career throughout was one of public activity and usefulness.

Mr. Sterne was a writer of much force and effectiveness upon political and economic questions. In 1865 he published the *Social Science Review*. His principal works were, "Our Representative Government and Personal Representation" (1871), "Suffrage in Cities" (1878), "Hindrances to Prosperity" (1879), and a "Constitutional History and Political Development of the United States" (1882).

F. W. CLARKE.

Robert Henry Thurston.

1839–1903.

Robert Henry Thurston, son of Robert L. Thurston, was born October 25, 1839, in Providence, R. I. During childhood and youth he spent much time in his father's shops (Thurston, Green & Co. and Thurston, Gardner & Co.) where he became acquainted with the engineering practice of the day, especially in relation to the design and construction of steam engines and boilers and general power plant work. In 1859 he graduated at Brown University with the degrees of Ph.B. and C.E. From the same institution he later received the degrees of A.M. and LL.D.

For two years he was engaged with his father's firm, first at Providence and later as their representative in Philadelphia. In 1861, when the Civil War broke out and the question of service to country became the uppermost thought in the hearts of all patriots, he decided early in the summer to offer himself for service in the engineer corps of the navy, as that branch of the public service which best accorded with his personal tastes and in which his previous experience might be of the highest value. In accordance with this offer he was ordered to report to the naval examining Board in session at Philadelphia. This he did on July 9, 1861, and was examined in due course on the 25th of the same month. His commission as Third Assistant Engineer U. S. N. was made out under date of July 30, 1861, and on August 25 he was ordered to the U. S. S. *Unadilla* at the Brooklyn Navy Yard. This vessel was fitting out for service in southern waters and was put in commission September 30, sailing on October 18 and reporting in due time to Admiral Dupont at Port Royal, S. C. After service in this vicinity for about a year the vessel was ordered north to New York for repairs, returning again in October, 1862. During the following winter the *Princess Royal* was taken as a prize, and Assistant Engineer Thurston was ordered home in her in charge of the Engineer's Department. This prize was taken in to

Philadelphia which port was reached on February 8, 1863. Assistant Engineer Thurston was then detached and ordered on February 11 to examination for promotion. This gave him the rank of Second Assistant Engineer. Following the examination he was placed on waiting orders where he remained till June 13, 1863, when he was ordered to the *Chippewa* at Port Royal in charge of the Engineer's Department. About a year later the ship returned north to Philadelphia where he was detached on June 23, 1864, and placed on waiting orders. On July 11, 1864, he was ordered to the *Maumee* at the Brooklyn Navy Yard, but a few weeks later, on August 10, was detached and ordered to the *Pontoosuc*. This vessel saw service as consort to a Pacific Mail steamer to Aspinwall and return. On October 18, 1864, he was detached from the *Pontoosuc* and ordered to the *Dictator*, then fitting out and making preliminary trials in New York harbor. On June 6, 1865, he was ordered to examination for promotion to First Assistant Engineer, receiving his commission as such dated July 18. Shortly after on September 5, 1865, he was detached and placed on waiting orders till December of the same year when he was ordered to the Naval Academy as Assistant Professor in the Department of Natural and Experimental Philosophy.

He remained at the Naval Academy till 1870 when he was invited to the chair of Mechanical Engineering at the recently founded Stevens Institute. Here he organized this department of the Institute, started an engineering laboratory and directed for 15 years, or until 1885, the energies of this growing center of engineering educational influence. In addition to his work at Stevens Institute he took part in many important pieces of engineering work and served on many government commissions. Among these may be mentioned the U. S. Commission on Boiler Tests, the U. S. Board to test iron, steel and other metals, and the U. S. Commission to the Vienna Exposition in 1873, the report of which he edited, writing Vol. III as his own contribution to the work.

In 1885 he was invited by the Trustees of Cornell University to undertake the reorganization of Sibley College as a professional engineering school.

This work was undertaken with all the advantages which his experience at the Naval Academy and at Stevens Institute had naturally brought, and the constant advancement and improvement of Sibley College as an educational power formed the subject of his unceasing and most strenuous efforts up to the very day of his death.

He also found time here for many important pieces of public work and served on the U. S. Commission on pneumatic postal equipment, the New York Commission on Voting Machines, and the New York State Commission to report on a modern rifle for the National Guard.

As a writer he was most prolific, his published papers and addresses numbering somewhere about 300. His most important books are:

Manual of the Steam Engine, two volumes, 1890–91; Manual of Steam Boilers, 1890; Engine and Boiler Trials, 1890; History of the Steam Engine, 1878; Materials of Engineering, three volumes, 1882–86; Friction and Lost Work, 1883.

Professor Thurston also made several inventions, among which many be mentioned: lamps burning magnesium, navy signal apparatus, testing machines for iron and other metals, testing machines for lubricants, and improvements in the steam engine and in scientific and engineering apparatus. He also did much work in scientific research and in the investigation of important engineering problems, among which may be mentioned:

The determination of the useful qualities of the alloys of copper and tin, copper and zinc, and copper, tin and zinc.

Studies of boiler explosions.

Researches regarding the laws of friction and lubrication.

Laws of variation of engine wastes and studies in the economy of the steam engine.

Professor Thurston was a member of the leading engineering and scientific societies of this country and of Europe. He was the first President of the American Society of Mechanical Engineers and succeeded himself for the following term as well. He was three times Vice-President of the American Association for the Advancement of Science, Vice-President of the American Institute of Mining Engineers and Officer de l'Instruction Publique de France.

Proc. Wash. Acad. Sci., February, 1904.

Professor Thurston enjoyed to an unusually high degree the capacity for rapid and intensive work, and this, joined to a broadly sympathetic nature, led him to cover with his professional activities an unusually wide field and enabled him to show in the aggregate a productive result of astonishing magnitude. His greatest monument, however, is undoubtedly represented by the organization and development of Sibley College, and if in detail this work was shared by others, such fact in no wise detracts from his credit, but is rather the further evidence of his capacity as an organizer and administrator, and for finding such personnel as was needed for the attainment of his ends, and for directing their energies successfully toward this goal.

Personally Professor Thurston was warm hearted, sympathetic, optimistic, and a most agreeable friend and companion. In matters of a scientific nature he was quick in forming his judgments and rapid in carrying them to execution. In matters involving broader questions of policy he was more slow in forming a final judgment, but once formed was tireless in carrying it forward to realization. He was never discouraged by any appearance of failure, and was strong in the faith that some day the great purposes with which he was associated would all work out to the best and highest uses of mankind. He died on October 25, 1903, on his 64th birthday, in the full possession of all his faculties, and with apparently many years yet of useful activity before him.

While it may be too soon to estimate with exactness his place in the galaxy of the great minds which the 19th century produced, yet among those whose work adorned the latter part of this century, the name of Robert Henry Thurston will have an assured and abiding place. As an engineer, a scientist, an educator, a writer, an investigator, an expert and counsellor, as a public servant in many capacities, and as a man and good citizen; all of these fields of activity have been enriched with his labors and with his unswerving spirit of devotion to scientific truth. He has left to the new generation a rich legacy in work actually accomplished, and in the example of a scientist and engineer faithful and true to the highest principles and standards of life.

W. F. DURAND.

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Note. — New names in **blackface** type, synonyms in *italics*.