

AVIAN HOSTS OF THE GENUS ISOSPORA (COCCIDIIDA)*

DONALD C. BOUGHTON†

With the assistance of

RUTH B. BOUGHTON AND JOSEPH VOLK

As a background for studies on avian coccidiosis it is desirable to know which bird-groups are parasitized by the different genera of Coccidia. To this end the present writer (5) listed the records of the presence of *Eimeria* and *Isospora* by bird orders. It was found, in general, that *Eimeria* was associated with the "lower" orders, and *Isospora*, with the "higher." As a further step toward an understanding of the distribution of avian Coccidia, the present paper assembles the species and sub-species of birds which are known to be capable of harboring *Isospora*.

The data for the host list are derived from three sources: records in the literature; certain unpublished records of Dr. Dora P. Henry; and personal observations. The first two are based upon examinations of hosts killed in their natural habitats. This method has the advantage that it often makes possible histological studies. On the other hand, there are at least two objections to this method. In the first place the hosts must be sacrificed; in the second, replicate observations on questionable cases are impossible. This last point is of particular importance. When the decision between infection and non-infection rests upon the interpretation given to the presence of a few oocysts in the digestive tract, as is the case in many instances, it is of particular advantage to be able to re-examine

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†Zoology Department, University of Georgia, Athens, Ga.

the host under conditions such that a passive ingestion of extraneous oocysts can be ruled out. Of necessity, the records on killed specimens have been taken at face value. The records of the present writer are based on examinations of fecal samples of living birds; some of these were wild birds trapped for examination in their natural habitats and others were captive birds in zoological gardens or pet shops. In the latter group, infections may have been acquired after capture from sources not available in the normal habitats of the hosts. This, however, has no bearing upon the main point of the survey, which is to demonstrate the ability of various bird species to harbor *Isospora*. As a matter of fact many captive birds are probably naturally infected and retain chronic infections over long periods. Such a condition is certainly true for captive house sparrows (6) and is presumably true for certain birds of paradise (3, 4).

The list of hosts is arranged by orders and families, according to Wetmore's classification (25). For each bird species (subspecies when possible) the following details are given: scientific name; common name; a generalized geographical range of the host; a reference to the coccidian species involved, whenever noted as such by an observer; a reference to the authority or authorities for the presence of *Isospora*; and the locality in which the observation was made. In so far as possible, the correct scientific names of hosts, according to the latest nomenclature, are employed. The geographical ranges are included merely as an aid in orientation of host species and to emphasize the world-wide distribution of *Isospora*; the significance of natural habitats in regard to source of infection in the case of captive birds has been discussed above. When a species of *Isospora* has been associated with a given host, this fact is indicated by a Roman numeral which refers to the numbered list of coccidian species given in the text; if no name has been employed the notation "*I. sp.*" is used. Authorities for the presence of *Isospora* are indicated by numbers in parentheses, which refer to the numbered list of references at the end of the paper. Unpublished records of Dr. Henry are designated by (14a); when not preceded by a reference to the literature, they constitute new records. The writer's present records are indicated by (*) for captive birds in zoological gardens or pet shops, and by (**) for wild hosts trapped for observation; when not preceded by a reference to a previous observation, these also constitute

new records. All birds reported here for the first time as hosts of *Isospora* are designated by a dagger (†) placed in front of the scientific name.

The following species of avian *Isospora* have been described:

- I. *I. lacazii* (Labbé, 1893) from the goldfinch, lark, and other unnamed birds (16). From subsequent host lists (17, 18), the two hosts can be identified as *Carduelis carduelis carduelis* (Linn.) and *Alauda arvensis arvensis* Linn. respectively. In 1896 Labbé (17) listed 30 passerine hosts of this species and in 1899 (18) added several more, most of which had been reported by Sjöbring in 1897 (21). In his second and third papers (17, 18) Labbé gave the species as *lacazei*, a spelling which has been employed by most authors since that time. As Henry (14) points out, however, the correct spelling is *lacazii* as originally given by Labbé (16).
- Synonyms:
- Ia. *I. rivoltae* (Labbé, 1893) from the chaffinch, shrike, titmouse, and other unnamed birds (16). From subsequent host lists, the three hosts can be identified as *Fringilla coelebs coelebs* Linn., *Lanius collurio collurio* (Linn.), *Parus caeruleus caeruleus* Linn. respectively. In his 1896 paper Labbé (17) abandons this species and considers all forms as belonging to *lacazei* (= *lacazii*).
- Ib. *I. communis-passerum* Sjöbring, 1897, from a number of passerine birds (21).
- II. *I. lyruri* Galli-Valerio, 1931, from the black grouse, *Lyrurus tetrrix tetrrix* (Linn.) (9). Later Galli-Valerio (10) reports this species from the capercailly, *Tetrao urogallus urogallus* Linn.
- III. *I. buteonis* Henry, 1932, from hawks and owls (14). The original host records include: *Accipiter cooperii* (Bonaparte), *Buteo borealis calurus* Cassin, *B. swainsoni* Bonaparte, *Falco sparverius sparverius* Linn., and *Asio flammeus flammeus* (Pontoppidan). A later observation (14a) adds *Bubo virginianus pallescens* Stone.
- IV. *I. strigis* Yakimoff and Matschoulsky, 1937, from the short-eared owl, *Asio flammeus leucopsis* (Brem) (29).
- V. *I. nucifragae* Galli Valerio, 1933, from the nutcracker, *Nucifraga caryocatactes caryocatactes* (Linn.) (11).
- VI. *I. volki* Boughton, 1937, from Lawes' six-plumed bird of paradise, *Parotia lawesi lawesi* Ramsay and 10 other birds of paradise (4).
- VII. *I. monedulae* Yakimoff and Matschoulsky, 1936, from the collared jackdaw, *Corvus monedula collaris* Drummond (28).
- I. henryi* originally described (26) from *Bubo bubo bubo* has been placed in the genus *Caryospora* (27), which is not considered in this paper.

It is not clear from the text of Labbé's 1896 paper (17) whether or not he re-examined the five hosts originally reported (16), but in the present host list he is given credit for so doing.

Records for hosts listed by Labbé in 1899 (18) but not given in his earlier papers are not attributed to him in this paper if they had been published by Sjöbring in 1897 (21). The latter (21) includes two hosts without giving species names (*Fringilla* sp. and *Sylvia* sp.), for which no notation is given in the present host list. Hadley (12) and Johnson (15) incorrectly placed the coccidia found by them in certain passerine birds in the genera *Eimeria* and *Cyclospora* respectively. Sufficient evidence has been presented (22, 1) to show that they were actually dealing with *Isospora*, and their records are included here.

It is not the purpose of this paper to discuss the species of avian *Isospora* in detail, but rather to organize our present knowledge of the distribution of the genus in bird hosts. However, a few remarks on the difficulties of species description in this group may be in order, especially since these difficulties seem to have been too easily set aside by various describers of new coccidian species.

Although the hurried application of a name may be defended, perhaps, on the ground that it provides a convenient handle for subsequent manipulation of the observations—including the final toss into oblivion—nevertheless, limited accounts based on a few oocysts from one or two uncontrolled hosts are not always convincing as descriptions of new species. This appears to be true in the case of avian coccidia for the following reasons:

(a). The actual source of the oocysts may be in doubt, as discussed above.

(b). Oocyst-size, which certainly must be relied upon to some extent, is not without its limitations as a criterion for species differentiation. Some time ago, the writer (2) undertook a detailed study of this character in natural Isosporan infections in English sparrows. The mean size of oocysts varied so much that a single set of 50 or 100 measurements could not be considered representative of the infection as a whole. If we assume that mean size and variability in size remain constant for a given species under various conditions, then the statistically significant differences demonstrated for oocysts from sparrows must be due to the presence of more than one species in the same host. It follows that unless a natural infection is observed for some time, in order to check for significant variations, the possibility that a single host may harbor more than one species must be considered, and until this is ruled out, an isolated series of measurements can have little specific value. Further, it is

not impossible that two species may have statistically identical measurements.

(c). Cross infection experiments seem to be required, especially in the case of passerine infections. Sjöbring (21) suggested that there may be several varieties of coccidia in small birds, each one being pathogenic for its particular host. Laveran (19) and Wasielewski (23) have likewise pointed out the need for cross-innoculation experiments. After examining the oocysts from a number of passerine birds, Henry (14) was led to deliver the following ultimatum: “. . . one must draw the conclusion that only one species, *Isospora lacazii*, is represented. At least, with our present methods of differentiation of species, no other conclusion is possible. If experiments could be carried out with these species as easily as with chickens, our knowledge of this form might be extended.”

In the present state of our knowledge, it would seem more important to study the distribution of the genus *Isospora* among avian-groups than to establish species. Detailed studies on certain hosts recorded in this paper may eventually aid in the latter. Perhaps it will be possible to study host-specificity by using super-imposed infections. In only one case thus far, the birds of paradise, do the writer's observations seem to warrant the description of a new species. This has been done elsewhere (5).

The following list of avian hosts of *Isospora* includes 176 species and sub-species of birds, representing 130 genera, 40 families, and 9 orders. Over half of these (94 out of 175) are new host records.

BIRD HOSTS OF *Isospora*

ORDER FALCONIFORMES

FAMILY ACCIPITRIDAE—HAWKS

Accipiter cooperii (Bonaparte). Cooper's hawk. U. S., III (14). California.

Buteo borealis calurus Cassin. Western red-tailed hawk. U. S., III (14). California.

Buteo swainsoni Bonaparte. Swainson's hawk. U. S., III (14). California.

Haliastur indus intermedius (Gurney). Malayan Brahminy kite. P. I., I. sp. (13). P. I.

FAMILY FALCONIDAE—FALCONS

Falco sparverius sparverius Linn. Eastern sparrow hawk. U. S., III (14). California.

Microhierax erythrogenys (Vigors). Philippine falconet. P. I., I. sp. (13). P. I.

ORDER GALLIFORMES

FAMILY TETRAONIDAE—GROUSE

Tetrao urogallus urogallus Linn. Capercailly. Eu., II (10). Switzerland
Lyrurus tetrix tetrix (Linn.). Black grouse. Eu., II (9). Switzerland.

ORDER CHARADRIIFORMES

FAMILY CHARADRIIDAE—PLOVERS, TURNSTONES, SURF-BIRDS

Vanellus vanellus (Linn.). European lapwing. Eu., I. sp. (20). Italy.
Charadrius vociferus vociferus (Linn.). Killdeer. U. S., I (14). California.

ORDER CUCULIFORMES

FAMILY MUSOPHAGIDAE—PLAIN-TAIN-EATERS

†*Turacus leucotis donaldsoni* Sharpe. Donaldson's Turaco. Afr., I. sp. (*). New York City.

FAMILY CUCULIDAE—CUCKOOS

Cuculus canorus canorus Linn. European cuckoo. Eu., Ib (21). Sweden.

ORDER STRIGIFORMES

FAMILY STRIGIDAE—OWLS

†*Bubo virginianus pallescens* Stone. Western horned owl. U. S., III (14a). Washington.
Asio flammeus flammeus (Pontoppidan). Short-eared owl. U. S., III (14, 14a). California, Washington.
Asio flammeus leucopsis (Brem). Siberian short-eared owl. Asia, IV (29). Taschkent.

ORDER MICROPODIFORMES

FAMILY MICROPODIDAE—SWIFTS

Apus apus apus (Linn.). European swift. Eu., I (17). France.

ORDER CORACIIFORMES

FAMILY ALCEDINIDAE—KINGFISHERS

Alcedo atthis ispida Linn. European kingfisher. Eu., I (17). France.
Halcyon coromandus (Latham). Ruddy kingfisher. P. I., I. sp. (13). P. I.

FAMILY CORACIIDAE—ROLLERS

Coracias garrulus garrulus Linn. European roller. Eu., I (17). France.

FAMILY UPUPIDAE—HOOPoes

Upupa epops epops. European Hoopoe. Eu., I (17). France.

ORDER PICIFORMES

FAMILY CAPITONIDAE—BARBETS

- †*Cyanops asiatica asiatica* (Latham). Blue-cheeked barbet. India, *I. sp.* (*). New York City.

FAMILY PICIDAE—WOODPECKERS

- †*Colaptes auratus luteus* Bangs. Northern flicker. U. S., *I. sp.* (**). Ohio.
Colaptes cafer collaris (Gmelin). Western red-shafted flicker. U. S.,
 I (14). California.
Picus viridis viridis Linn. Green woodpecker. Eu., Ib, I (21, 9).
 Sweden, Switzerland.
Dryobates minor comminutus (Hart). Br. lesser-spotted woodpecker.
 Eu., I (18). France.
Jynx torquilla torquilla Linn. Wryneck. Eu. Ib (21). Sweden.

ORDER PASSERIFORMES

FAMILY TYRANNIDAE—NEW WORLD FLYCATCHERS

- †*Sayornis phoebe* (Latham). Eastern phoebe. U. S., *I. sp.* (**). Ohio.

FAMILY ALAUDIDAE—LARKS

- Alauda arvensis arvensis* Linn. European skylark. Eu., I (16, 17, 19,
 23). France (twice), Germany.
Galerida cristata cristata (Linn.). Crested lark. Eu., I (17). France.
 †*Otocoris alpestris alpestris* (Linn.). Northern horned lark. U. S., *I. sp.*
 (**). New Jersey.
 †*Otocoris alpestris actia* Oberholser. California horned lark. U. S., *I. sp.*
 (14a). California.

FAMILY HIRUNDINIDAE SWALLOWS

- Riparia riparia riparia* (Linn.). Bank swallow. Eu., I (17). France.
Hirundo urbica urbica Linn. European martin. Eu., I (17). France.
Chelidon rustica rustica (Linn.). European swallow. Eu., I (17). France.

FAMILY CAMPEPHAGIDAE—CUCKOO-SHRIKES

- Lalage niger* (Forster). Pied lalage. P. I., *I. sp.* (13). P. I.

FAMILY ORIOLIDAE—OLD WORLD ORIOLES

- Oriolus oriolus oriolus* (Linn.). European golden oriole. Eu., I (17).
 France.

FAMILY CORVIDAE—JAYS, CROWS, MAGPIES

- †*Amphelocoma californica californica* (Vigors). California jay. U. S.,
I. sp. (14a). California.
 †*Amphelocoma californica immanis* Grinnell. Long-tailed jay. U. S.,
I. sp. (14a). California.
 †*Amphelocoma californica oocleptica* Swarth. Nicasio jay. U. S., *I. sp.*
 (14a). California.
Corvus brachyrynchos brachyrynchos Brehm. Eastern crow. U. S.,
I. sp. (1, **). Minnesota, New Jersey.

- †*Corvus brachyrhynchos hesperis* Ridgway. Western crow. U. S., I. sp. (14a). California.
- †*Corvus caurinus* Baird. Northwestern crow. U. S., I. sp. (14a). Washington.
- Corvus cornix cornix* Linn. Hooded crow. Eu., Ib (21). Sweden.
- Corvus corone corone* Linn. European carrion crow. Eu., I (17, 23). France, Germany.
- Corvus monedula collaris* Drummond. Collared jackdaw. Asia, VII (28). Taschkent.
- Nucifraga caryocatactes caryocatactes* (Linn.). Nutcracker. Eu., V (11). Switzerland.
- †*Dendrocitta rufa rufa* (Latham). Wandering tree magpie. India, I. sp. (*). New York City.
- †*Pica pica pica* Linn. European magpie. Eu., I. sp. (*). New York City.

FAMILY PARADISEIDAE—BIRDS OF PARADISE

- Paradisaea apoda apoda* Linn. Greater bird of paradise. New Guinea, VI (4). New York City.
- Paradisaea apoda salvadori* Mayr and Rand. Count Salvadori's bird of paradise. New Guinea, VI (4). New York City.
- Paradisaea guilelmi* Cabanis. Emperor of Germany's bird of paradise. New Guinea, VI (4). New York City.
- Paradisaea minor minor* Shaw. Lesser bird of paradise. New Guinea, VI, (4). New York City.
- Paradisornis rudolphi rudolphi* Finsch. Prince Rudolph's bird of paradise. New Guinea, VI (4). New York City.
- Parotia lawesi lawesi* Ramsay. Lawes' six-plumed bird of paradise. New Guinea, VI (3, 4). Milwaukee, New York City.
- Epimachus meyeri meyeri* Finsch. Long-tailed bird of paradise. New Guinea, VI (4). New York City.
- Seleucidés melanoleucus melanoleucus* (Daudin). Twelve-wired bird of paradise. New Guinea, VI (4). New York City.
- Lophorina superba minor* Ramsay. Lesser superb bird of paradise. New Guinea, VI (4). New York City.
- Uranornis rubra* (Daudin). Red bird of paradise. New Guinea, VI (4). New York City.
- Manucodia chalybatus orientalis* Salvadori. Blue manucode. Papuan Islands, VI (4). New York City.

FAMILY PARIDAE—TITMICE

- Parus caeruleus caeruleus* Linn. Continental blue titmouse. Eu., Ia, I (16, 17). France.
- Parus major major* Linn. Great titmouse. Eu., I (23). Germany.
- †*Baeolophus inornatus inornatus* (Gambel). Plain titmouse. U. S., I. sp. (14a). California.

FAMILY SITTIDAE—NUTHATCHES

- †*Sitta carolinensis carolinensis* Latham. Northern white-breasted nuthatch. U. S., I. sp. (**). Ohio.
- †*Sitta carolinensis aculeata* Cassin. Slender-billed nuthatch. U. S., I. sp. (14a). California.

FAMILY TIMALIIDAE—BABBLING THRUSHES

- †*Leioptila capistrata capistrata* (Vigors). Black-headed sibia. India, *I. sp.* (*). New York City.
- †*Pyctorhis sinensis sinensis* (Gmelin). Golden-eyed babbler. India, *I. sp.* (*). New York City.
- †*Mesia argentauris argentauris* Hodgson. Silver-eared hill-tit. India, *I. sp.* (*). New York City.
- †*Liothrix lutea lutea* (Scopoli). Red-billed hill-tit. China, *I. sp.* (*). New York City.
- †*Garrulax leucolophus leucolophus* (Hardwicke). White headed jay thrush. India, *I. sp.* (*). New York City.
- †*Garrulax albogularis albogularis* (Gould). White-throated jay thrush. India, *I. sp.* (*). New York City.
- †*Trochalopteryx lineatum* (Vigors). Streaked jay thrush. India, *I. sp.* (*). New York City.

FAMILY PYCNONOTIDAE—BULBULS

- †*Otocompsa flaviventris flaviventris* (Tick.). Black-crested yellow bulbul. India, *I. sp.* (*). New York City.
- †*Chloropsis aurifrons aurifrons* (Temm.). Golden-fronted green bulbul. India, *I. sp.* (*). New York City.
- †*Molpastes haemorrhous bengalensis* Blyth. Bengal black bulbul. India, *I. sp.* (*). New York City.

FAMILY TROGLODYTIDAE—WRENS

- †*Troglodytes aëdon aëdon* Vieillot. Eastern house wren. U. S., *I. sp.* (**). Ohio.

FAMILY MIMIDAE—THRASHERS, MOCKINGBIRDS

- †*Mimus polyglottos leucopterus* (Vigors). Western mockingbird. U. S., *I. sp.* (14a). California.
- †*Mimus gilvus melanopterus* Lawrence. Black-winged mockingbird. S. A., *I. sp.* (*). New York City.
- †*Dumetella carolinensis* (Linn.). Catbird. U. S., *I. sp.* (**). Ohio.
- †*Toxostoma rufum* (Linn.). Brown thrasher. U. S., *I. sp.* (**). Ohio.
- †*Melanotus caerulescens* (Swainson). Blue mockingthrush. C. A., *I. sp.* (*). Milwaukee.

FAMILY TURDIDAE—THRUSHES

- Turdus migratorius migratorius* Linn. Eastern robin. U. S., *I. sp.* (12, **). Rhode Island, Wisconsin.
- Turdus migratorius propinquus* Ridgway. Western robin. U. S., I (14). California.
- Turdus merula merula* Linn. European blackbird. Eu., I (17, 9). France, Switzerland.
- Turdus iliacus iliacus* Linn. Redwing. Eu., I (8). Switzerland.
- †*Turdus torquatus alpestris* (Brehm). Alpine ring ouzel. Eu., *I. sp.* (*). Milwaukee.
- Hylocichla guttata faxoni* Bangs and Penard. Eastern hermit thrush. U. S., *I. sp.* (12). Rhode Island.

- †*Ixoreus naevius meruloides* (Swainson). Northern varied thrush. U. S., I. sp. (14a). Washington.
- †*Arceuthornis musicus musicus* (Linn.). Red-winged thrush. Eu., I. sp. (*). New York City.
- †*Arceuthornis philomelos philomelos* (Brehm). Continental song thrush. Eu., I. sp. (*). New York City.
- Kittacincla malabarica malabarica* (Scopoli). Indian shama thrush. India, I. sp. (*). New York City.
- †*Sialia sialis sialis* (Linn.). Eastern bluebird. U. S., I. sp. (**). Ohio.
- †*Sialia mexicana occidentalis* Townsend. Western bluebird. U. S., I. sp. (14a). California.
- Oenanthe oenanthe oenanthe* (Linn.). European wheatear. Eu., I. sp. (17). France.
- Erithacus rubecula rubecula* (Linn.). Continental robin redbreast. Eu., I (20, 17). Italy, France.
- Erithacus phoenicurus* (Linn.)? Nightingale. Eu., Ib (21). Sweden.

FAMILY SYLVIIDAE—OLD WORLD WARBLERS

- Sylvia atricapilla atricapilla* (Linn.). Blackcap warbler. Eu., I (20, 17). Italy, France.
- Sylvia borin* (Boddaert). Garden warbler. Eu., I (17, 23). France, Germany.

FAMILY REGULIDAE—KINGLETS

- †*Regulus satrapa satrapa* Lichtenstein. Eastern golden-crowned kinglet. U. S., I. sp. (**). New Jersey.
- †*Polioptila caerulea amoenissima* Grinnell. Western gnatcatcher. U. S., I. sp. (14a). California.

FAMILY MUSCICAPIDAE—OLD WORLD FLYCATCHERS

- Fridecula hypoleuca hypoleuca* (Pallas). Pied flycatcher. Eu., Ib (21). Sweden.

FAMILY MOTACILLIDAE—WAGTAILS, PIPITS

- Motacilla alba alba* Linn. White wagtail. Eu., I, Ib (17, 21). France, Sweden.
- Motacilla flava flava* Linn. Blue-headed wagtail. Eu., I (17). France.
- Anthus pratensis pratensis* Linn. European meadow pipit. Eu., I (17). France.
- †*Anthus spinoletta rubescens* (Tunstall). American pipit. U. S., I. sp. (14a). California.

FAMILY LANIIDAE—SHRIKES

- Lanius collurio collurio* (Linn.). Red-backed shrike. Eu., Ia, Ib (16, 21). Sweden.
- Otomela lucionensis* (Linn.). Gray-headed shrike. P. I., I. sp. (13). P. I.

FAMILY STURNIDAE (INCLUDING GRACULIDAE)—STARLINGS, MYNAHS

- Sturnus vulgaris vulgaris* Linn. European starling. Eu., U. S., I, I. sp. (17, **). France, Ohio.
- Sturnia sinensis* (Gmelin). Gray-backed starling. P. I., I. sp. (13). P. I.

- †*Sturnia malabarica malabarica* (Gmelin). Malabar mynah. India, *I. sp.* (*). New York City.
 †*Creatophora carunculata* (Gmelin). Wattled starling. Afr., *I. sp.* (*). New York City.
 †*Temenuchus pagodarum* (Gmelin). Black-headed mynah. India, *I. sp.* (*). Milwaukee.
Aethiopsar cristatellus cristatellus (Linn.). Crested mynah. P. I., *I. sp.* (13). P. I.
 †*Gracula religiosa religiosa* Linn. Javan hill mynah. Java, *I. sp.* (*). Milwaukee.
 †*Gracula indica* (Cuvier). Lesser hill mynah. India, *I. sp.* (*). New York City.
 †*Galeospar salvadorii* Sharpe. Crested glossy starling. Afr., *I. sp.* (*). New York City.
 †*Spreo superbus* (Rupp.). Superb glossy starling. Afr., *I. sp.* (*). Milwaukee.
 †*Lamprocorax panayensis halcytipus* Oberholser. Malay glossy starling. Afr., *I. sp.* (*). Milwaukee.

FAMILY VIREONIDAE—VIREOS

- †*Vireo olivaceus* (Linn.). Red-eyed vireo. U. S., *I. sp.* (**). Ohio.

FAMILY COEREBIDAE—HONEY-CREEPERS

- †*Cyanerpes cyaneus* (Linn.). Honey-creeper. S. A., *I. sp.* (*). Milwaukee.

FAMILY COMPSOTHTYLPIDAE—WOOD WARBLERS

- †*Geothlypis trichas brachidactyla* (Swainson). Northern yellow-throat. U. S., *I. sp.* (**). Ohio.

FAMILY PLOCEIDAE—WEAVER-FINCHES

- †*Euodice cantans cantans* (Gmelin). African silverbill. Afr., *I. sp.* (*). New York City.
Euodice malabarica } Hybrid, Bengalee mannikin. Afr., *I. sp.* (*).
 †*Uroloncha tsriata tsriata* } New York City.
 †*Ploceus velatus arundinarius* (Burch.). Cape or masked weaver. Afr., *I. sp.* (*). Milwaukee.
Padda oryzivora (Linn.). White Java sparrow. Java, *I. sp.* (13, *). P. I., New York City.
 †*Taeniopygia castanotis castanotis* (Gould). Zebra finch. Australia, *I. sp.* (*). New York City.
 †*Amandava amandava* (Linn.). Strawberry finch. India, *I. sp.* (*). New York City.
Amadina erythrocephala (Linn.). Red-headed finch. Afr., *I. sp.* (*). New York City.
 †*Estrilda astrild astrild* (Linn.). St. Helena waxbill. Afr., *I. sp.* (*). New York City.
 †*Estrilda melpoda melpoda* (Vieillot). Orange-cheeked waxbill. Afr., *I. sp.* (*). New York City.
Passer domesticus domesticus (Linn.). English sparrow. Eu., U. S. I (Many authors). *Vide* (6).

Passer montanus montanus (Linn.). Mountain or European tree sparrow. Eu., *I. sp.*, I (13, 9). P. I., Switzerland.

Passer italiae (Vieillot). Italian sparrow. Eu., *I. sp.* (20). Italy.

FAMILY ICTERIDAE—BLACKBIRDS, TROUPIALS

†*Icterus icterus icterus* (Linn.). Common troupial. S. A., *I. sp.* (*). New York City, Miami.

†*Icterus bullockii* (Swainson). Bullock's oriole. U. S., *I. sp.* (14a). California.

†*Gymnomystax mexicanus* (Linn.). Giant oriole. S. A., *I. sp.* (*). New York City.

†*Sturnella neglecta* Audubon. Western meadowlark. U. S., *I. sp.* (14a). California.

Euphagus cyanocephalus (Wagler). Brewer's blackbird. U. S., *I. sp.* (15, 14a). Washington (twice).

†*Xanthocephalus xanthocephalus* (Bonaparte). Yellow-headed blackbird. U. S., *I. sp.* (14a). California.

†*Leistes militaris superciliosus* (Bonaparte). Argentine red-breasted blackbird. S. A., *I. sp.* (*). New York City.

†*Agelaius phoeniceus californicus* Nelson. Bicolored red-winged blackbird. U. S., *I. sp.* (14a). California.

†*Quiscalus quiscula aeneus* Ridgway. Bronzed grackle. U. S., *I. sp.* (**). Ohio.

†*Molothrus ater ater* (Boddaert). Eastern cowbird. U. S., *I. sp.* (**). Ohio.

FAMILY THRAUPIDAE—TANAGERS

†*Thraupis palmarum palmarum* (Wied). Southern palm tanager. S. A., *I. sp.* (*). New York City.

†*Rhamphocelus brasileus* (Linn.). Brazilian silver-beaked tanager. S. A., *I. sp.* (*). Milwaukee.

†*Rhamphocelus carbo carbo* (Pallas). Southern silver-beaked tanager. S. A., *I. sp.* (*). New York City.

†*Cissopis leveriana* (Gmelin). Magpie-tanager. S. A., *I. sp.* (*). New York City.

FAMILY FRINGILLIDAE—GROSBEAKS, FINCHES, BUNTINGS

†*Richmondia cardinalis carinalis* (Linn.). Eastern cardinal. U. S., *I. sp.* (**). Ohio.

†*Hydymeloides ludovicianus* (Linn.). Rose-breasted grosbeak. U. S., *I. sp.* (**). Ohio.

†*Passerina ciris* (Linn.). Painted bunting. C. A., *I. sp.* (*). Milwaukee. *Emberiza citrinella citrinella* Linn. Yellow hammer. Eu., I, Ib (17, 21, 23, *). France, Sweden, Germany, New York City.

†*Sycalis flaveola flaveola* (Linn.). Common saffron finch. S. A., *I. sp.* (*). New York City.

†*Spinus tristis tristis* (Linn.). Eastern goldfinch. U. S., *I. sp.* (**). Ohio.

Carduelis carduelis carduelis (Linn.). European goldfinch. Eu., Ia, I (16, 17, 9). France, Switzerland.

Acanthis cannabina cannabina (Linn.). Linnet. Eu., I (17, 23). France, Germany.

- Chloris chloris chloris* (Linn.). European green finch. Eu., I (17). France.
- Fringilla coelebs coelebs* Linn. Chaffinch. Eu., Ia, I (16, 17, 23). France, Germany.
- Fringilla montifringilla* Linn. Brambling. Eu., I (17). France.
- Coccothraustes coccothraustes coccothraustes* (Linn.). European hawfinch. Eu., I. sp., I (7, 8, 10). Italy, Switzerland (twice).
- Pyrrhula pyrrhula pileata* Macgillivray. British bullfinch. Eu., I (17). France.
- †*Carpodacus mexicanus frontalis* (Say). Common house finch. U. S., I. sp. (14a). California.
- †*Carpodacus purpureus purpureus* (Gmelin). Eastern purple finch. U. S., I. sp. (**). Ohio.
- †*Pipilo erythrophthalmus erythrophthalmus* (Linn.). Red-eyed towhee. U. S., I. sp. (**). Ohio.
- †*Pipilo fuscus albigula* Baird. San Lucas towhee. U. S., I. sp. (14a). California.
- †*Pipilo maculatus falcifer* McGregor. San Francisco towhee. U. S., I. sp. (14a). California.
- †*Passerculus sandwichensis savanna* (Wilson). Eastern Savannah sparrow. U. S., I. sp. (**). Ohio.
- Melospiza melodia melodia* (Wilson). Eastern song sparrow. U. S., I. sp. (**). Ohio, Minnesota.
- †*Chondestes grammacus strigatus* Swainson. Western lark sparrow. U. S., I. sp. (14a). California.
- Junco hyemalis hyemalis* (Linn.). Slate-colored junco. U. S., I. sp. (12). Rhode Island.
- †*Junco oreganus oreganus* (Townsend). Oregon junco. U. S., I. sp. (14a). California.
- Zonotrichia albicollis* (Gmelin). White-throated sparrow. U. S., I. sp. (12, **). Rhode Island, New Jersey.
- †*Zonotrichia leucophrys leucophrys* (Forster). White-crowned sparrow. U. S., I. sp. (14a). California.
- †*Zonotrichia leucophrys gambeli* (Nuttall). Gambel's sparrow. U. S., I. sp. (14a). California.
- †*Zonotrichia coronata* (Pallas). Golden-crowned sparrow. U. S., I. sp. (14a). California.
- †*Spizella passerina passernia* (Bechstein). Eastern chipping sparrow. I. sp. (**). Ohio.
- †*Spizella passerina arizonae* Coues. Western chipping sparrow. U. S., I. sp. (14a). California.
- Spizella pusilla pusilla* (Wilson). Eastern field sparrow. U. S., I. sp. (12, **). Rhode Island, Ohio.

* Author's record on captive bird.

** Author's record on wild bird.

† New host for *Isospora*.

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| I. <i>I. lacazii</i> (Labbé, 1893). | IV. <i>I. strigis</i> Yakimoff and Mat., 1937. |
| Ia. <i>I. rivoltae</i> (Labbé, 1893). | V. <i>I. nucifragae</i> Galli-Valerio, 1933. |
| Ib. <i>I. communis-passerum</i> Sjöbring, 1897. | VI. <i>I. volki</i> Boughton, 1937. |
| II. <i>I. lyruri</i> Galli-Valerio, 1931. | VII. <i>I. monedulae</i> Yakimoff and Mat., 1936. |
| III. <i>I. buteonis</i> Henry, 1932. | |

SUMMARY

The list of avian hosts of the genus *Isospora* recorded in this paper is comprised of 176 species and sub-species of birds. These represent 130 genera, 40 families, and 9 orders. Of the entire list, 94 hosts are reported for the first time: 27 through the courtesy of Dr. Dora P. Henry and 67 representing the author's own observations. Of the latter, 21 were wild hosts examined in their natural habitats and 46 were captive birds.

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