the manner of attaining the result tabulated. Several standard designations, such as culmen from nostril, culmen from juncture of skull, culmen to base, would make plain the figures now found under the heading of "culmen."

Geographic distribution plus measurements certainly tell a significant story in systematic work. The less one writes about probable and possible differences and the more one can show by tables of measurements and diagrams, the more useful and intelligible are one's results. As in other branches of science, vague average measurements and general statements cannot be considered of equal value with detailed lists. This is no less true because, to some, such precise tabulations of locality, sex, and measurements are uninteresting.

My aim in this paper has been to help arouse ornithologists to establish uniformity in methods of measurements where possible and in any other cases to describe the manner in which the measurement was taken.

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BIRD BANDING AND BIRD MIGRATION WORK AT ROSSITTEN ON THE BALTIC SEA.

BY THEODOR G. AHRENS.

I. FOUNDATION, HISTORY AND OBJECTS OF THE STATION.

I. AT THE annual meeting of the German Ornithological Society (Deutsche Ornithologische Gesellschaft) in October 1900 in Leipzig, which was at the same time its fiftieth anniversary, Professor Thienemann made an address in which he demonstrated the great importance of the narrow peninsula known as the 'Kurische Nehrung' in East Prussia for the observation of bird migration. He described, how annually in the spring and autumn the Nehrung is traversed by countless thousands of birds on their migration. He then suggested that a bird station for the observation of the mysteries connected with bird migration should be founded at Rossitten. The Kurische Nehrung is 97 km. long from Kranz on the peninsula of Samland, to Memel, at which point it is cut

through, and the waters of the Kurisches Haff, the large lagoon lying between the Nehrung and the mainland, find an outlet to the Baltic. The Nehrung varies in width from ½ to 3 or 3½ kilometers and consists of dunes and occasional forests. Quite a number of moose are found here, the forests furnishing a safe cover and rigid protection being enforced.

The village of Rossitten is about 35 km. from Kranz and is built on one of the wider portions of the Nehrung. It was chosen for the station, as the birds in their migrations are accustomed to cross the Nehrung some 7 km. south of Rossitten. The German Ornithological Society took up Thienemann's suggestion with enthusiasm, the Prussian government promised aid and on January 1, 1901, the station was opened. Thienemann was made director and has continued in this position ever since.

In 1907 the State provided a small building for the station, containing a laboratory and a museum of birds collected on the Nehrung—till then only provisional quarters had existed. In 1908, a small house was erected at Ulmenhorst some 7 km. south of Rossitten at the point where the birds cross the Nehrung. This special observatory was destroyed by communists after the war, but it is being rebuilt and will be ready for occupancy this fall. In 1920, the Emperor William Foundation for the Promotion of Scientific Research purchased a large building at Rossitten, the present station, and presented it to the German Ornithological Society for its purposes. In it the large amount of material collected is set up and suitable laboratories furnished for visiting ornithologists, etc. The ever increasing number of visitors to Rossitten and the great general interest aroused in the public at large by the work conducted there, decided Professor Thienemann to introduce courses of instruction which are open to all and are generally held in May. These courses enjoy great popularity and consist in thorough instruction in methods of practical bird protection, particularly in those of Freiherr von Berlepsch, and also in a study of the habits of domestic wild birds. Artificial bird nests, suitable places for feeding the birds in winter and a bird thicket which has been planted in the neighborhood demonstrate the methods discussed in the courses, and the participants are taken upon excursions, where they can study the flight, the songs and other habits of the birds.

The scientific activities of the Station are concerned according to statute with the following matters:

1. General observation of bird migration and in particular of (a) the periods of the year and times of day of the migration of the individual species; (b) the direction taken; (c) the numbers of birds in the different groups and their general composition; (d) the subdivisions of the species in the migrating groups, according to age and sex; (e) weather and wind conditions during the migration, before and after them and the presumable influence of these factors upon the migration; (f) the height above ground taken by the birds; (g) Their speed during migration and experiments upon the speed of birds in general; (h) The rest stations of the migratory birds and their return; (i) the places of origin of the migratory birds.

2. Observation of bird habits and their dependence upon food conditions. Variations in the habits of breeding birds, birds of passage and migratory birds.

3. Examination of molting, coloration, and plumages of the birds in different ages and periods of the year, times for these changes and their commencement.

4. Investigations of the economic value of the birds and, in particular of (*a*) the food of the birds at different times and places; (*b*) of the benefits and damage to agriculture and silviculture, horticulture and pisciculture to be derived from the feeding habits of individual bird species. (*c*) distribution of plants and lower animal life, brought about by birds.

5. Investigations of practical methods of bird protection, as (*a*) conservation and increase of bird life by the planting of suitable undergrowth and the location of artificial nests; (*b*) experiments in the conservation of bird life with the aid of suitable methods of winter feeding, special attention being paid to game birds; (*c*) proposals for obtaining legal regulations to protect bird life.

6. Foundation and continuation of a collection of the birds, indigenous to or living on the Nehrung, or its vicinity in the museum of Rossitten.

7. Procuring laboratory specimens for scientific institutions.

8. Endeavors to spread the knowledge of domestic wild bird life in general and its economic value—particularly by means of lectures and literature.

9. Out of the above propositions has grown and been developed, chiefly through Thienemann's efforts, the banding of migratory birds which has not only served to answer many of the questions propounded, but has increased the acquaintance with bird life and migration to a very great extent, making the Rossitten bird station known all over the world.

II. DESCRIPTION OF ROSSITTEN, THE STATION AND ENVIRONMENT, BASED UPON A PERSONAL VISIT THERE IN AUGUST 1922.

II. I made a visit to Rossitten in the summer of 1922, and spent four days on the Nehrung in company with Dr. Procháska, a Tschech ornithologist from Prague. Rossitten is a primitive fishing village and is reached by steamboat from Kranz every other day, during the summer months in about two hours. Professor Thienemann has a little wooden house with a fine library and many interesting things collected by him from time to time. The house occupied by the Bird Station is a large commodious dwelling with the Museum, containing a very notable collection of birds indigenous to the neighborhood and stray specimens shot and captured at one time or other. For instance, two parrots (possibly escaped cage birds from some vessel), maps with the routes taken by different birds, collections of bands used here and at other stations, and relics, consisting of bird legs with the bands still attached, sent from South Africa, Barbados and various remote places, newspaper articles, letters, etc., referring to birds banded at Rossitten and reported upon.

Professor Thienemann is a man about 50 years of age, and looks younger. He is erect and alert, has a most winning personality, full of enthusiasm and a prodigious capacity for work. He has a home in Königsberg, where he has a nominal position connected with the Department of Zoology at the University, but his whole life and energies are devoted to Rossitten. This year he had his sister as a regular assistant. She traced bird migration routes on the maps, and looked after the Museum during visitors' hours. Thienemann goes to the observation station at Ulmenhorst towards the end of September and stays there till the end of the migration period. There he notes down his observations of speed, numbers

of birds and any new phenomena he may observe. He personally superintends the banding operations which, in the great majority of cases, are carried out in the spring and early summer, nestlings being generally selected. He also took us to the observation station at Ulmenhorst, some 7 km. southwards, where a new house is being built for the observation of migration. It will contain sleeping quarters, laboratories for visitors who wish to observe the migrations, etc. This point is most interesting. On one side you have the Baltic, on the other vast wander dunes, and beyond the waters of the Haff, so wide that the mainland coast cannot be seen. To the north the forest, to the south dunes and desert. At this point the swarms of migrating birds cross, and here the observations of speed, height, etc. are made. We saw frequent tracks of moose made only a few hours before, but moose themselves did not appear. The wander dunes are a most interesting phenomenon. About 1756, the Russians who had occupied the Nehrung deforested the whole peninsula. In consequence the sand drifted from the Baltic side eastward and formed great dunes, engulfing in the course of time several viallges. These dunes move from 8–10 m. eastwards annually and as they are now secured by plantations and other methods, and do not increase, it is estimated that in about 100 years they will have entirely disappeared in the waters of the Haff.

III. REMARKS UPON BIRD MIGRATION, AS OBSERVED AT ROSSITTEN, AND THE PROBLEMS CONNECTED WITH IT.

III. As regards the results of the observation of bird migration at Rossitten, we have stated that the most favorable position for observation is not Rossitten, but a point 7 km. south of it, where the forest which covers the central portion of the Nehrung ceases and treeless sand dunes are found for many miles. At this point the Nehrung is so narrow that the whole width of the peninsula can be overlooked from the Baltic coast to the banks of the Haff (the lagoon between the Nehrung and mainland). At this point high wander dunes are situated.

As an example I give a short description of observations made on a good migration day in October. As soon as the day breaks the

first flocks of Crows make their appearance, larger and larger swarms of these birds succeeding one another in long chains. Shortly after, flocks of Wild Pigeons and swarms of Starlings (*Sturnus vulgaris*) at high speed and making a great noise with their wings. *Lullula arborea* (Heidelerchen, Wood Lark), in small flocks, larger groups, again, of *Fringilla coelebs* (Buchfinken, Chaffinch), and of *Acanthis linaria holbolii* (Leinzeisig, Holboll's Redpoll).—These smaller birds frequently descend and take a brief rest on the bushes and trees in the neighborhood. Varieties of Thrushes (*Turdus*) pass overhead; Geese in wedge formation, Cranes and Wild Swan. Among all these birds now and then birds of prey appear. *Buteo buteo* (Mause bussard, Common Buzzard), *Archibuteo lagopus* (Rauhfussbussard, Rough-legged Buzzard), *Accipiter nisus* (Sperber, Sparrow Hawk), *Falco peregrinus* (Wanderfalke, Peregrine Falcon), *Falco regulus* (Merlin) and once in a while, perhaps, a *Haliœetus albicilla* (Seeadler, White-tailed Eagle). The migratory instinct causes these mutual enemies to fly together peacefully. Great numbers of *Regulus regulus* (Goldhähnchen, Golden-crested Wren), *Erithacus rubecula* (Rotkelcken, Red-breast) hop around from bush to bush, for these smaller birds do not keep up a steady flight. In the above manner the migratory flight continues uninterruptedly, till about noon and then gradually ceases. Such good days as just described, are rather rare at Rossitten, but still occur during every migration period. On October 10, 1912, for instance, no less than 26 species were observed and at least 29,000 birds flew across the Nehrung. A problem that has much occupied Rossitten is how the birds migrate, i.e., old birds and young together, male and female together or separately. If, for instance, old and young birds traveled together, the experience of the old ones would aid the young ones during flight. In *Fringilla coelebs*, for instance, the sexes migrate separately. Cases are known, however in which the young birds fly alone and are thus unable to have a leader, and must be guided by instinct exclusively.

Observations seem to prove that the young of the following species precede the older birds when migrating. *Totanus glareola, Circus macrurus, Cerchneis vespertina* (Kestrel) and *tinnunculus.*

Another interesting problem is that of the height above ground, taken by the migrating birds. Altitudes of 5000 to 6000 meters had been formerly considered possible, but apart from the scientific improbability of these heights (cold, adverse air currents, etc.) observations made continuously and accurately have shown that in general a height of 100 meters is the rule. Crows, Starlings and birds of prey rise to greater heights in quiet weather, but even then only a few hundred meters, so that the characteristic silhouettes of their spreading wings may be clearly distinguished.

The speed of birds during migration has also been much overestimated. At Ulmenhorst, the place of observation, the following rates of speed, based upon experiments, have been accurately noted:

1.	*Sturnus vulgaris*, Starling	20.6 m. per sec.
2.	*Coloeus monedula* (Dohle,) Jackdaw	17.1 m. " "
3.	*Loxia curvirostra* (Kreuzschnabel,) Crossbill	16.6 m. " "
4.	*Falco peregrinus*, Peregrine Falcon,	16.45 m. " "
5.	*Chrysomitris spinus* (Zeisig,) Siskin,	15.5 m. " "
6.	*Fringilla coelebs*, Chaffinch,	14.6 m. " "
7.	*Corvus frugilegus*, Rook,	14.5 m. " "
8.	*Corvus cornix*, Hooded Crow,	13.9 m. " "
9.	*Larus fuscus*, Lesser Black-back Gull,	13.8 m. " "
10.	*Accipiter nisus*, Sparrow Hawk,	11.5 m. " "

IV. THE BANDING OF BIRDS AS PRACTISED AT ROSSITTEN AND SOME OF ITS PRACTICAL RESULTS.

IV. Although bird banding in a desultory manner had been practised for some years previous, the first man to take up the matter systematically and scientifically was the Danish college Professor Mortensen, who began in 1899 with Starlings, Storks, Ducks and sea birds. Thienemann took up banding in 1903 and has made it the chief object of his work at Rossitten. By frequent articles, published everywhere he endeavored to bring the importance of banding, and reporting upon banded birds before the general public. By means of banding, regular reliable maps of the routes taken by Storks, *Larus ridibundus*, *Corvus cornix* and others have been made.

Seven different-sized aluminum bands are used at Rossitten with the letters running from A to G to denote the sizes. The bands are numbered continuously, according to series, marked with their respective letter and have the words *Bird Station, Rossitten, Germany,* for the large bands and only *Rossitten* for the smaller. The bands are used as follows:

Series A: *Halieatus albicilla* (Seeadler), White-tailed Eagle.
Aquila chrysaetos (Steinadler).
Otis tarda (Trappe), Bustard.
Grus grus (Kranich), Crane.

Series B: *Ciconia ciconia* (*stork*).
Ardea cinerea (Fischreiher), Heron.
Botaurus stellaris (Rohrdommel), Bittern.
Phalacrocorax carbo (Kormoran), Cormorant.
Anseridae,
Pandion haliaetus (Fischadler), Osprey.
Aquila clanga (Schreiadler), Spotted Eagle.

Series C: *Astur palumbarius* (Habicht), Goshawk.
Falco peregrinus (Wanderfalke), Peregrine Falcon.
Milvus ater (Milan), Black Kite.
Buteo buteo (Bussard), Buzzard.
Corvus corax (Kohlrabe), Raven.
Anas boschas (Stockente), Mallard.
Colymbus cristatus (Haubentaucher), Great Crested Grebe.

Series D: *Circus pygargus* (Rohrweibe).
Phasianus colchicus (Fasan) (English Pheasant).
Corvidae

Series E: *Accipiter nisus* (Sperber), Sparrow Hawk.
Cerchneis tinnunculus (Turmfalke), Kestrel.
Lycos monedula (Dohle), Rook.
Cuculus canorus (Kuckuck), Cuckoo.
Limosa ———— (Schnepfe).
Larus ridibundus, Black-hooded Gull.

Series F: *Turdus* Thrushes, Starlings, Picidae, Woodpeckers.
Regenpfeifer, Strandlaufer (*Tringa*), Sandpipers.
Charadriidae, Plovers.

Series G: Small birds.

V. ROUTES TAKEN BY EUROPEAN BIRDS WHEN MIGRATING.

V. As regards the routes taken by birds some of the most interesting results should be stated. The Common Stork (*Ciconia ciconia*) has winter quarters in South Africa in the region of the East African Lakes, Kalahari Desert, Rhodesia, Transvaal, Orange Free State, Cape Colony. The distance from Northern Europe where the Storks pass the summer is some 10,000 km. and instead of taking a direct route, observations made by banding have shown that two main (roundabout) routes are taken.

1. A southeastern route via Hungary, Balkan countries, Bosphorus and Dardanelles to Asia Minor and thence through Syria to Egypt and via the Nile to Central and South Africa.

2. A southwestern route via France, Spain, Gibralter to Morocco, thence across the Sahara using oases as resting places. Both of these routes are land routes, showing that the Stork dislikes a flight across the Mediterranean.

Larus ridibundus which breeds along the coasts of the North Sea and Baltic wanders along the coast westward to the British Channel, or continues along the coasts of France and Spain to North Africa; others go down the Rhine and Rhone valleys and spend the winter in the western Mediterranean countries. Lyons and its neighborhood is a region largely visited by Baltic gulls.

Before the war notices of banded birds seen or shot there were frequently sent to Rossitten. Gulls banded at Rossitten have been picked up in the Gulf of Mexico, Feb. 1912, and on the island of Barbados, November, 1911. Snipe from North Russia go along the coast to England, or southwesterly through Germany to south France, Spain, Italy, Sardinia, Corsica and Africa. In the main the following general migratory routes for European birds have been determined, based upon banding records.

1. A western coast route—from east to west along the Baltic and North Sea to England, the north coast of France, the west coast of France to Spain and North Africa. This route is taken notably by Gulls and Terns; Scolopacidae, (Tringa, Gallinago, Scolopax); Oyster Catcher; Lapwing, Ducks; Cranes; Crows; Starlings; and Thrushes.

2. An Adriatic-Tunisian route, along the coasts of the Adriatic, Sicily to Tunis. By Laridae (*Larus ridibundus*); Scolopacidae; Gruidae; many small song birds.

3. An Italian-Spanish route from Austria-Hungary via North Italy, Po Valley to Corsica, Sardinia, Balearic Islands to South France and Spain: By Laridae; Charadriidae; Scolopacidae, etc.

From 1903–1919, 7,778 birds were banded at Rossitten and, besides 123,569 bands were distributed to outsiders. Of these 7,778 banded birds, 2,011 have been accounted for by reports received at the station. Observations now extending over 19 years have proved conclusively, that banding is not injurious to the birds and that it does not disturb or change their habits. All attacks made upon science by over-conscientious bird protectors have been disproven as based either upon misapprehension or upon wilful misrepresentation.

Berlin, Germany

THE CONNECTICUT VALLEY—A HIGHWAY FOR BIRD MIGRATION.[1]

BY AARON C. BAGG.

Plates. XVI-XVII

TRAILS are perpetually fascinating. From the dawn of history the wanderings of men and later, certain of their trade routes continually attract our attention. Just how a group became established in a given locality; by what route various hordes poured over a mountain-barrier or across a body of water; why another tribe did not remain settled or stationary but persisted in continual travel—all these are problems which the student of history likes to puzzle over. So in the study of ornithology the routes traversed by birds of passage equally charm the student or the layman. Long before white men braved the mad Atlantic to explore a new world or the warriors of the Six Nations established the now

[1] Paper read before the Allen Bird Club of Springfield, Mass., Feb. 6, 1922.

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