PLANS for enlarging the present six-story biological and research laboratory at the Willard Parker Hospital of New York were filed by the department of health. The improvement will consist of an eight-story addition in East Sixteenth Street, between Avenue C and the East River. The annex will increase the hospital's plottage from 82 by 42 feet to 148 by 88 feet and will cost $700,000. The plans also provide for renovating the interior and renewal of equipment.

A LARGE observatory is now being built for the Geophysical Institute of the University of Leipzig. The building, which will be surmounted by an eighty-foot tower, is being erected on solid rock in a forest on the Colm at Oschatz, a suburb of Leipzig. Nearby, in a small quarry, an "earthquake cellar" will be excavated for the observatory's seismograph, and two further buildings will be erected for the study of terrestrial magnetism. The main building will be chiefly devoted to the study of atmospheric electricity. All investigations will be carried out along the lines of international geophysical research.

ONE half of one gram of radium was delivered from Belgium on September 18 to the cancer division of Bellevue Hospital in New York. The total consignment, valued at $175,000, will be used exclusively in cancer treatments.

DR. HERBERT S. DICKEY, explorer and ethnologist, returned recently after five and a half months' absence during which he made his fifth expedition up the Orinoco River and discovered its source, hitherto unvisited by white men. Arriving on the Munson liner *Munamar,* he stated that the source of this great river is not in Venezuela, but actually in Brazil, some sixty miles west of the Parima Mountains, the dividing line between the two countries.

THE graduate division of the school of geography at Clark University has established headquarters at Wellfleet, Mass., for the fifth annual Clark Field School of Geography under supervision of Dr. W. Elmer Ekblaw, Dr. Wallace W. Atwood, Sr., president of the university, and Dr. Wallace W. Atwood, Jr. The group will survey the lower arm of the cape and then move the camp either to Brewster or Barnstable. The study is one step in what will eventually be a complete study of Massachusetts. During the past four years the Connecticut Valley has been the object of study.

WE learn from the *Journal* of the American Medical Association that March 24, 1932, will be the fiftieth anniversary of the discovery by Robert Koch of the tubercle bacillus. The federal minister of the interior and the minister of the Prussian department of welfare have taken the initial steps to inaugurate suitable ceremonies in commemoration of the event. From May 17 to May 20, 1932, a commemorative assembly will be held in Berlin. On May 18 there will be a special commemorative session, in which German and foreign scientific men will participate, and on May 19 and 20 further scientific sessions will be held. It is planned also to reorganize under the name of the Robert Koch-Gedächtnis-Stiftung the Robert Koch foundation that was disorganized during the inflation period, and, above all, the importance of Koch as a scientist will be brought before the people in a suitable manner. Reichspräsident v. Hindenburg has consented to serve as the patron of the undertaking, and the imperial chancellor will be the honorary chairman of the committee on arrangements. In addition, a committee to aid in the organization of the scientific assembly will be appointed, to consist of German and foreign scientists and investigators.

THE New Jersey state department of conservation and development has put into operation a new forest nursery to meet increased demands for tree seedlings and to provide better conditions for raising species best suited for planting in South Jersey. The nursery, which is located in the Green Bank State Forest, near Green Bank, Burlington County, will have an ultimate capacity of 6,000,000 seedlings.

TWO excellent specimens of the Persian wild ass and four of the Persian wild goat have been received at the Field Museum as a result of the recent expedition conducted by James E. Baum, Jr. In the near future, one or more of the animals will be mounted for exhibition.

DISCUSSION

BILATERAL GYNANDROMORPHISM AND LATERAL HEMIHYPERTROPHY IN BIRDS

BILATERAL gynandromorphism in birds constitutes a well-marked class of abnormalities, cases of which are, however, very rare. There are only ten cases recorded in the literature, more or less completely. In five of these cases there is agreement between external and internal sex characters of the same side of the body; the right side of the body possesses a testis internally and male plumage externally, while ovary or ovotestis (one case) and female plumage appear on the left side. These are the cases of Lorenz[1] (*Pyrrhula*),

[1] Th. Lorenz, *Bull.* de la Soc. des Nat., Moscow, n. s. 8, 325 (see p. 333), 1894.

of Weber[2] (*Fringilla*), of Heinroth and Poll[3, 4] (*Pyrrhula*), of Tikhomoroff[5] (*Pyrrhula*) and of Ogneff and Ogneff[6] (*Pyrrhula*). The apparently clean-cut situation presented by these cases has aroused great interest on account of its resemblance to the well-known bilateral gynandromorphs of insects. This resemblance naturally suggests an explanation similar to that demonstrated for the gynandromorphs of *Drosophila, i.e.,* somatic disjunction of sex-chromosomes. Such an explanation is, however, in conflict with an equally well-established principle of a physiological order, *viz.,* that the sex-characters of the plumage of birds are controlled by the female hormone which circulates in the blood, hence equally to the two sides of the body.

It is because the even distribution of the female sex hormone *seems* to exclude an explanation of bipartite distribution of sex-characters of plumage on a hormonal basis alone that the theory of somatic disjunction of sex-chromosomes is still appealed to as part at least of the explanation of this phenomenon. I shall, however, attempt to show that the principle of threshold of hormone action, as demonstrated for plumage characters by Juhn, Faulkner and Gustavson[7] and by Lillie and Juhn (in press) furnishes a complete explanation of the bipartite plumage characters in the five cases already cited, as well as in the other cases; the other abnormalities of all the cases also fall into well-known physiological categories.

We may first note that the theory of somatic disjunction of sex-chromosomes is of very doubtful validity as applied to this problem, even though advocated by Bond[8] and Goldschmidt,[9] and favored by Macklin[10] and Zawadowsky.[11] This is for the reason that it has been demonstrated on a large scale by experiments on fowls, both by surgical methods (see especially Domm[12]), and by injection of chemically prepared sex hormones (Juhn and Gustavson,[13] Juhn, Faulkner and Gustavson,[7] and Lillie and Juhn (in press)) that the sex of the soma makes no difference in the reaction of feather germs to the sex hormones. So far as sex-characters of plumage are concerned the male hormone is without any action, and the female hormone impresses the female characters on all feather germs of tracts exhibiting sex dimorphism, whether on a male or a female bird. The same would certainly be true, if one side of a single individual were male in its sex chromosome composition and the other side female. Somatic disjunction of sex chromosomes, even if granted, would therefore not help in explaining the phenomenon, unless it were shown that a different threshold of reaction exists for genetically male and genetically female feather germs. This assumption has no experimental support. So far as our experiments go, though not directed specifically to this exact point, no difference of threshold has been suspected between corresponding feather tracts in males and females.

The difficulty in the theory of somatic disjunction of sex chromosomes as applied to the problem in question does not, moreover, stop here. In the case of Bond's pheasant, for instance, not only was there a sex difference in the plumage of the two sides of the body, but the outer half of each tail feather was male and the inner half female *on both sides of the body.* We would therefore have to assume a second somatic disjunction for half of the germ of each tail feather on the male side of the body; and on the female side to provide for reacquisition of a lost chromosome in exactly half of each feather germ involved. That the plumage characters on the two sides of the body are not purely male or female in gynandromorph birds has also been noted by Lorenz[1] and Neunzig.[14]

Leaving aside therefore the sex chromosome mechanism, let us see how the matter can be explained on a purely physiological basis. We shall confine ourselves at first to plumage characters. The female hormone is the differentiating factor. The principle established by Juhn and Gustavson[13] and farther elaborated by Juhn, Faulkner and Gustavson[7] in my laboratory, *viz.,* that the threshold of reaction of feather germs to the female hormone is a direct function of their growth rate furnishes the basis of the explanation. By virtue of this principle they were able to produce from capons, at a given dosage of female hormone, birds in which the slowly growing saddle feathers, for instance, changed during regeneration to female, while the more rapidly growing breast feathers remained male. These are thus "transverse gynandromorphs" in plumage characters in the usual sense, but produced by a difference of hormone threshold in different feather tracts.

Now it must be noted here that, when a normal con-

[2] Max Weber, *Zool. Anz.,* 13, 508, 1890; Cabanis, *Journ. f. Ornithol.,* p. 344 (cited from Weber), 1874.

[3] O. Heinroth, Sitz. ber. Ges. naturf. Freunde zu Berlin, p. 328, 1909.

[4] H. Poll, *ibid.,* p. 331, 1909.

[5] A. Tikhomorow, *Rev. Zool. Russe,* 2, 196, 1918.

[6] Ogneff and S. Ogneff, *Rev. Zool. Russe,* 4, 259, 1924.

[7] Mary Juhn, G. H. Faulkner and R. G. Gustavson, *Journ. Exp. Zool.,* 58, 69, 1931.

[8] C. J. Bond, *Journ. of Genet.,* 3, 205, 1913.

[9] R. Goldschmidt, "Die sexuellen Zwischenstufen," Julius Springer, Berlin, 1931. See p. 479.

[10] M. T. Macklin, *Journ. Exp. Zool.,* 38, 355, 1923.

[11] M. M. Zawadowsky, *Arch. f. Entw. Mech.,* 108, 563, 1926.

[12] L. V. Domm, *Journ. Exp. Zool.,* 48, 31, 1927.

[13] Mary Juhn and R. G. Gustavson, *Journ. Exp. Zool.,* 56, 31, 1930.

[14] R. Neunzig, "Die gefiederte Welt," 53, 93, 1924.

centration of female hormone is present in the blood, all dimorphic feather tracts produce female feathers; this is the normal female condition. Gynandromorph conditions in the plumage, therefore, are dependent on a subnormal amount of female hormone, which can be regulated by dosage in castrates, as in the above experiments, or by ovarian deficiency, as in partially ovariotomized birds.

It is known that a testis usually develops on the right side of ovariotomized birds, owing to compensatory hypertrophy of the rudimentary right gonad (Domm[12] and Appel[15] and others). The existence of a testis on the right side and ovary on the left is presumptive evidence of ovarian deficiency in birds; and it is to be noted that the ovary is small in the case of gynandromorph birds, and generally immature, though it is difficult to be certain to what extent this may be due to seasonal conditions. In Bond's case there was an ovotestis on the left side and no gonad on the right, so that there is a lack of correspondence of internal and external gynandromorphism.

The presumption is therefore strongly in favor of a condition of ovarian deficiency in all cases, seven in number, in which the condition of the reproductive organs is reported. We have, therefore, in these birds conditions favorable for the occurrence of gynandromorph conditions in the plumage. The problem to be solved is its bilateral distribution, whether in the plumage as a whole, or in individual feathers as in Bond's case.

If the cases in the literature be examined again, a very striking fact comes to light, which has not hitherto been emphasized, *viz.,* that the side on which the male plumage appears is hypertrophied as compared with the opposite side in the four cases in which data exist. Thus in Poll's case the author notes incidentally that the right wing is much larger than the left; the photograph, moreover, gives the impression that the right tarsus is also longer and heavier than the left. In Ogneff and Ogneff's case the right wing is similarly reported to be somewhat longer than the left. In Neunzig's case, also of *Pyrrhula,* it is the left side that exhibits the male plumage, the right side being predominantly female. Although the author fails to mention asymmetry, yet his figure of the bird shows the left foot very much larger than the right. In Bond's case the left tarsus and phalanges are larger than the right, and there are other evidences of hypertrophy of the left side, which is the male side in this case. The hypertrophy occurs on opposite sides in these cases, two on the right and two on the left, and *the male plumage is on the hypertrophied side in each case.* Macklin's case was an extreme example of hemihypertrophy (right), but unfortunately the fowl was plucked before it was received for study, so that the plumage characters were known by report only and very incompletely. In the other cases, six in number, no observations were recorded on symmetry or asymmetry.

Congenital hemihypertrophy in man is well known clinically, though it is a rather rare condition. Gesell[16] made a particularly careful study of the condition. Stanton and Tuft[17] state that 41 cases were on record at that time; more cases have been recorded since. The right side is more often affected than the left, but the condition may occur on either side; it occurs in both males and females. Besides the differences in size on the two sides of the body, which are often extreme, the hypertrophied side, according to these authors, may exhibit excessive sebaceous and sweat secretion, thicker growth of hair, more rapid growth of nails, higher temperature by a degree or two, and earlier eruption of teeth.

The hypertrophied side has a higher growth rate than the normal side in the clinical cases, evidenced not only by the larger size of all parts, but also by the more rapid growth of continuously growing structures on this side, such as nails and hairs.

In a paper by Lillie and Juhn now ready for press it is shown that the patterns of individual feathers are largely dependent on a differential growth rate along the axes of the barbs. Moreover, in highly asymmetrical feathers, in which the level of growth rate of all the barbs of one side of the feather is higher than on the other, it is possible to produce bilateral gynandromorphism by injections of female hormone regulated so that its concentration is above the threshold of reaction on the less rapidly growing side and below it on the other.

Therefore, in cases of pronounced hemihypertrophy in birds, in which ovarian deficiency exists, we would expect that the plumage of the more rapidly growing (hypertrophied) side would be male, if the threshold corresponding to its growth rate were above the existing hormone concentration, while that of the opposite side might be female corresponding to a slower growth rate. The degree to which this condition would be expressed would depend on the time of origin of the ovarian deficiency and its duration and extent in relation to moulting periods. The condition need not be pure with reference to the two sides; this would be a matter of fluctuating concentration of the female hormone; and it is noticeable that in the case of Bond's pheasant, Neunzig's bulfinch and some other cases, it is far from being so, which constitutes an-

[15] F. W. Appel, *Journ. Exp. Zool.,* 53, 77, 1929.

[16] Arnold Gesell, *Arch. of Neur. and Psych.,* 6, 400, 1921.

[17] James Stanton and Louis Tuft, *Journ.* Am. Med. Ass., 80, 1,432, 1923.

other difficulty for the theory of somatic disjunction of chromosomes. Moreover, the same condition would account for the bilateral gynandromorphism of individual feathers.

These principles fit the situation so perfectly in all respect that I have no hesitation in presenting the theory that these gynandromorph birds are cases of hemihypertrophy combined with ovarian deficiency, as by far the most reasonable interpretation. The theory has the very great advantages of requiring no subsidiary hypotheses and of being in accord with well-known physiological principles.

If such lateral hemihypertrophy were to occur in a male bird, gynandromorph characters would not appear, for no ovarian tissue occurs in males. Crew's[18] case of lateral asymmetry in a male resulting from a cross between Light Sussex ♀ and a Rhode Island Red ♂ is a case in point. The bird was male externally and internally; the left side was much hypertrophied, especially in the skeleton, with the exception of the skull and vertebral column which were practically symmetrical. The left leg was pinky white, somewhat like the color in the Light Sussex, and the right leg yellow like the Rhode Island Red. This difference suggested the theory that an autosome carrying the dominant factor for white epidermal pigment had been eliminated during early cleavage divisions of a male zygote heterozygous for white and yellow, though it is somewhat difficult to correlate this with the general hypertrophy of the left side, as Crew admits. If, on the other hand, we assume that the lateral hemihypertrophy is the primary factor in this case, the other asymmetrical features might conceivably receive a consistent physiological explanation.

The data suggest that it would be profitable to look for cases of lateral hemihypertrophy in birds, with a view to ascertaining how common the phenomenon is, and what other asymmetrical characters may be associated with it. It would be particularly desirable to ascertain if in the female it is always associated with gonadal abnormalities, or whether the fact that it is so far known in females only in such association, is due to the interest that has attached to gynandromorphism and the lack of interest in asymmetry as such.

The interpretation of hemihypertrophy itself has been dealt with by Gesell[16] and by Newman.[19] Gesell is inclined to interpret it as incipient twinning, thus explaining the degree of physiological isolation that seems to exist in such cases. To the writer these cases seem to be classifiable as extremes of the asymmetry that characterizes bilaterality in all organisms or parts of organisms. It may be, of course, that exaggeration of asymmetry of the germ in early stages is one of the causes that leads to twinning, a suggestion that would reconcile these two points of view. In the feather system of birds there are all possible degrees of asymmetry of individual feathers ranging from the barely perceptible to the most extreme types, and these gradations have certain regular relations to position on the body.

Without discussing the question farther in this place we may conclude at once by saying that the problem is much more surely one of the physiology of bilateral asymmetry than of differences of genetic constitution on the two sides of the body.

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[18] F. A. E. Crew, *Journ. of Genetics*, 20, 179, 1928.
[19] H. H. Newman, "The Physiology of Twinning," 230 pp. University of Chicago Press. 1923.

ANGUILLULA ACETI—A DESIRABLE NEMA FOR TYPE STUDY

DR. N. A. COBB'S excellent summary of recent advances in nematology, in these pages, prompts the writer to give his own experience in teaching the subject. Early attempts with mixed classes of students forcefully demonstrated the impracticability of using such forms as *Ascaris* and *Gigantorhynchus*. Considerable friction invariably resulted, some students positively refusing to dissect these forms and even dropping the course. To eliminate this friction, search was made for other forms, the little vinegar eel, *Anguillula aceti*, being finally selected for type study. This nema yielded such satisfactory results that it was subsequently adopted by the writer for use in his general biology, zoology and parasitology classes.

The following reasons induced the above selection of *A. aceti*.

(1) It arouses real interest in and elicits favorable comments from the students.

(2) It may be procured at any time of the year from a corner grocery by asking for bulk cider vinegar.

(3) It will live indefinitely in the laboratory if transferred to fresh vinegar every two weeks.

(4) It is a simple nematode with a simple life history. The entire life history can be worked out in a single two-hour exercise.

(5) Being viviparous and transparent, all stages of development may be examined *in utero*.

(6) Anatomical details, such as alimentary tract, nerve ring, spicules and sperms of male, uterus and uterine development in female and all young and intermediate stages can be worked out with a 4 mm objective.

(7) Very spectacular effects can be produced by