factory. A combination of this method with the first one above is often helpful, and has been used in Chile.

Third, " the corrections at the standard station may be multiplied by a factor proportional to the daily range (or to the difference between midday and evening observations) at the station to be corrected." This method depends upon properly correcting for any difference in daily range which may exist between nearby stations, as, for instance, between hill and valley stations where the daily ranges may be quite different. But care must be used to see that the climates of the two places are similar, for the daily amplitude of variation may be the same, but the shape of the curve different. This was found to be the case in applying the method to Los Andes (valley) and Santiago (coastal slope), Chile, in which the amplitude is the same but the sharp night minimum at Los Andes was markedly different from that at Santiago.

The fourth, and last, method is that in which " all direct use of standard stations may be avoided and the reduction to true mean based on considerations connected with the general phenomena of the diurnal variation of temperature." This makes no use of standard stations but bases the whole system upon a normal diurnal curve which may be expressed by the Fourier series

$T_h = T + a_1 \sin (t_h + A_1) + a_2 \sin (2t_h + A_2)$,

in which the coefficients of the first and second harmonics may be calculated as follows:

$$a_1 = -0.72 + 0.44 \; (M - m),$$
$$a_2 = +0.54 + 0.08 \; (M - m).$$

This method has been thoroughly tested and has given satisfactory results, but is chiefly valuable when the stations are so situated that the other methods are not applicable.

A. Buchan favored the mean of the daily maximum and minimum as the most satisfactory expression of true mean temperature, and the view has become widely accepted. But there are objections, not only from the instrumental standpoint—for maximum and minimum thermometers are more likely to develop systematic errors than are dry-bulb thermometers—but also because the ratio of this mean to the true mean is dependent upon location, time of year, and cloudiness. For that reason, the author advises meteorologists in English-speaking countries to make less use of the mean of the daily extremes and more of suitable combinations of the observations at fixed hours, such as the first formula above.

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SPECIAL ARTICLES

ON THE ELIMINATION OF THE X-CHROMOSOME FROM THE EGG OF DROSOPHILA MELANOGASTER BY X-RAYS

SOME of the results of the investigation of the biological effects of X-rays point to a specific effect of the rays on the nuclear matter of the dividing cell and especialy the germ cell.

1. Actively growing tissue whether normal or pathological is the most susceptible to X-rays.

2. It has been found comparatively easy to sterilize a number of different species without apparently otherwise injuring them.

3. Perthes[1] has found that X-rays have a destructive effect on chromosomes in the ova of *Ascaris megalcephala.*

The experiments to be described were performed with a view to determining if X-rays by affecting the X-chromosome could disturb the inheritance of a sex-linked character. Wild type (red-eyed) females of *Drosophila melanogaster,* homozygous for red-eye, were X-rayed soon after emerging from the pupa with a dose just under the sterilization dose and mated to white-eyed males. Sisters of the rayed females were used as controls and mated to white-eyed males. The white eye color is sex-linked and recessive to the red and when there is no non-disjunction the offspring in tht first generation of a cross between a homozygous red-eyed female and a white-eyed male are all red-eyed.

In all, four experiments have been performed. In three of these, numbers 71, 76, and 77, thirty-five virgin females, homozygous for

1 Perthes, *Deut. Med. Woch.,* 30, 1904.

the red-eyed character, were mated with white-eyed males. Nineteen of these were used as controls and sixteen were X-rayed soon after emerging from the pupa and immediately before mating. The rayed females were the sisters of the controls. *None of the nineteen control pairs produced white-eyed males.* One of the rayed females was sterile. *Of the fifteen fertile rayed females, twelve produced one or more white-eyed males.* The total number of offspring in the first generation produced by the control pairs was 6579 (3367 ♂, 3212 ♀) all red-eyed, and by the pairs in which the females were rayed it was 2460 (1227 red-eyed ♂, 1211 red-eyed ♀, 20 white-eyed ♂ and 2 gynandromorphs). In the fourth experiment seven wild-type sister females were used, three were kept as controls and four were rayed. All were mated with white-eyed males. One of the control females produced one white-eyed male. Two of the three rayed females produced white-eyed males, one producing three and the other one.

In the first and fourth experiments the white-eyed males were also homozygous for the character, "dumpy," which is located in the second chromosome. Of the six white-eyed males produced in these experiments five had normal wings and the other died before its wings expanded.

Twenty-three out of the twenty-four exceptional white-eyed males came from eggs which were laid during the first six days after raying and mating. The other male came from an egg probably laid on the seventh day after raying. Further the exceptional white-eyed males divide themselves into two groups corresponding to eggs laid during the earlier part and the later part of this six day period.

That the presence of these white-eyed males could be due to natural non-disjunction and not to any effect of the X-rays seems extremely unlikely from the following considerations: In experiment 71, out of 7 fertile sisters the two which were X-rayed produced white-eyed males. The chance in a random picking of getting a particular two out of seven can be shown to be 1 in 42. We may add the results of experiments 76 and 77 since the females used in these experiments were all the offspring taken at random of two pairs. If the result here was not due to X-rays, then in taking at random 12 females from 26 for raying we must have taken the only 10 which produced white-eyed flies. The chance of doing this can be shown to be 1 in 9,600,000 tries.

Since the white-eyed males produced by the X-rayed females when crossed to white-eyed dumpy males were normal winged, the second chromosome of the female can not have been affected to the extent of the elimination of the gene for normal wing.

It may be stated that a repetition of these experiments is in progress and that a number of experiments have already been carried far enough to confirm the earlier findings.

In order to determine whether the whole or a part of the X-chromosome is affected by the X-rays, two strains with sex-linked characters have been used, both obtained through the kindness of H. H. Plough—an eosin-miniature stock and a scute-echinus-cut-vermilion-garnet-forked stock. Males of both of these stocks have been used in experiments similar to those described. In all cases so far the exceptional males produced by the X-rayed females (the control females have produced no exceptional males) have all the sex-linked characters.

Since the eggs which have produced the exceptional white-eyed males were probably rayed either 2 to 3 or 5 to 7 days before laying, there seems reason to believe that they were acted on by the X-rays while preparing for one of the maturation divisions. (Compare here the work of H. H. Plough, 1917, on the effect of temperature on crossing over.)

We know from the work of Stevens[2] and Metz[3] that the X-chromosomes of *Drosophila melanogaster* (*ampelophila*) behave, in the male, differently from the other chromosomes in the maturation divisions. If, as seems probable, the chromosomes during division go through a stage in which they are particularly susceptible to X-rays, then it would seem

[2] Stevens, *Proc. VII. International Zool. Cong.*, 1907.

[3] Metz, *Journ. Exp. Zool.*, 1914.

probable that the X-chromosomes may pass through that stage at a time different from that at which the other chromosomes pass. This would account for the production of the exceptional white-eyed males in the experiments if we consider that the X-rays were applied to the particular germ cell at a time when only the X-chromosome was in a condition suceptible to the dose given.

The writer wishes to express his great indebtedness to Dr. Willis R. Whitney, director of the Research Laboratory of the General Electric Company at whose suggestion work on fruit-flies was undertaken and without whose cooperation it could hardly have been done. He is also indebted to Mr. O. J. Irish for accurate and careful work as technical assistant throughout the investigation.

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EPIDEMIC PNEUMONIA IN REPTILES

DURING the spring and early summer months of 1919 there occurred an epidemic among the reptiles kept in captivity in the Bronx Zoological Gardens which resulted in the death of many of them.

The clinical course of this disease, if it may be considered the same disease in all, was difficult to follow on account of the well-known sluggishness of these animals, which often remain quiet for a long time and fail to eat anything. For this reason the attention of the caretakers was seldom attracted to sick animals until they were found dead. In some cases, however, it was observed that they suffered from an intense dyspnœa and held their mouths open in the effort to breathe. Others emitted a frothy, slimy exudate from the mouth and nostrils. Even then it was difficult to observe any other symptoms and the attempt to secure a series of observations on the temperature of the sick animals for comparison with that of several normal ones of the same sort could not be carried out successfully.

A great number of those which died were sent to the laboratory for autopsy and it is interesting that several turtles sent from the New York Aquarium were found to have died from the same disease. Careful autopsies were made upon all these animals and cultures and smears taken from the lungs and upper respiratory tract and usually also from the heart's blood. Other snakes and some rabbits, rats and mice were inoculated with the cultures derived from these cases.

Cases of pneumonia were studied at autopsy in the following animals, often in many individuals of the same species: *Iguana tuberculata, Zamenis lamelliformis* (Texas rattlesnake), *Trachyurus rugosus* (stump-tailed lizard), *Crotalus atrox* (Florida rattlesnake), *Ancistrodon contortrix* (copperhead), *Varanus gouldi* (Australian monitor), *Spilotes corais* (blacksnake), *Tupinambis teguexin* (yellow tegu), *Pityophis sayi* (bull snake), *Alligator mississippiensis, Anaconda, Chelonia imbricata* (hawksbill turtle), *Eutœnia sirtalis* (garter snake), *Coluber guttatus, Thalassochelys caretta* (loggerhead turtle), *Heloderma suspectum* (gila monster), *Ophibolus getulus* (king snake), *Chrysemys elegans* (Cumberland turtle), *Chrysemys picta* (painted turtle), *Tropidonotus fasciatus* (water snake), *Heterodon platyrrhinus,* and *Zamenis flagelliformis.*

The autopsies on these animals as a rule revealed a partial consolidation of the tubular spongy lung, various diverticula of the main bronchial cavity with their air cells being filled with an opaque blood-stained grayish exudate with occasional hæmorrhages in the surrounding tissue. In one instance (*Varanus*) there was also an acute pericarditis with yellowish effusion upon the surface of the heart.

Smears from the consolidated portions of such lungs showed the presence of great numbers of rather small gram negative bacilli, sometimes with a slight admixture of gram positive diplococcoid organisms but usually in practically pure culture.

Microscopically, the condition was fairly uniform in all. In *Crotalus atrox* many of the wide air cells were distended with compact masses of cellular exudate composed chiefly of leucocytes which are large with round vesic-