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No. 71

X-RAYS UPSET HEREDITY;
CONTROL FLIES' SEX.

Schenectady, N. Y. J

Producing red-eyed sons of white-eyed

mother fruit flies by application of X-rays and thus upsetting the natural heredity of these flies has been achieved by Dr. James W. Mavor in the biological laboratory of Union College, Schenectady.

Other investigators have made recent advances in the study of heredity in animals that indicate that such external agents as heat, food and X-rays may modify inheritance so that the offspring of a given pair of individuals may be made to be quite different from what they would be in the ordinary course of events. However, Dr. Mavor has been able to delve into the reproductive secrets of the fly and explain how and why the changes in heredity occur.

Among the hundreds of different forms, called mutations or sports, which have been found by those experimenting with these banana flies there are some whose inheritance is related to sex. If a white-eyed female fruit fly is mated with an ordinary red-eyed male individual of the same species, all the sons will be white-eyed like their mother and all the daughters will be red-eyed like their father. But if a white-eyed female fruit fly is treated with a certain dose of X-rays, the heredity can be modified so that some red-eyed sons and some white-eyed daughters will be produced. In some cases as many as twelve percent of the sons have been of this exceptional kind. Had it not been known that exceptional flies

like the above white-eyed daughters and red-eyed sons do very rarely arise in nature from matings of white-eyed females with red-eyed males one would have had little hesitation in calling them mutations. Since more is now known about heredity in the fruit fly than in any other animal, it is possible to explain exactly what the X-rays do.

It has been shown even to the satisfaction of the biological skeptic that hereditary qualities are passed from one generation to the next in certain very minute bodies called chromosomes, inside the germ cells and even smaller than them. These chromosomes occur in pairs and it is found that one pair, called the sex-chromosomes are concerned in determining sex. In the female fly the two sex-chromosomes are exactly alike and are called X chromosomes. In the male fly, on the other hand, the two sex-chromosomes are not alike. One is like those of the female and is also called the X chromosome and the other which is different from it is called the Y chromosome.

When the reproductive cells are formed the chromosomes of a pair are separated so that each egg cell contains only one of the X chromosomes. In the male this separation leads to the formation of two kinds of sperm cells, one kind containing one X chromosome and one kind containing one Y chromosome. When an egg is fertilized by a sperm containing an X chromosome it gives rise to a female and when it is fertilized by a sperm containing a Y chromosome it gives rise to a male.

It is now clear that the effect of the X-rays acting on the female fruit fly is to make her produce eggs which have either no X chromosomes or two X chromosomes instead of one. In the first case when an egg with no X chromosomes is fertilized by a sperm with an X chromosome from a red-eyed male it produces a red-eyed male like its father since the red eye character is transmitted in the X chromosome. Normally such an egg would have contained an X chromosome and when fertilized by a sperm containing an X chromosome it would have produced a red-eyed female. In the second case when an egg with two X chromosomes instead of one is fertilized by a sperm containing a Y chromosome it gives rise to a white-eyed female like its mother since both its X chromosomes have come from her. Normally the egg would have only one X chromosome and being fertilized by a sperm containing a Y chromosome it would produce a white-eyed male.

The number of these exceptional white-eyed daughters with cells containing two X chromosomes and a Y chromosome obtained as the result of treating their mothers with X-rays is not sufficient to make it certain that the daughters are fertile and reproduce their kind. It is known, however, that when such exceptional daughters occur from a natural mating, as they do in about one in twenty-thousand flies, they do produce other exceptional females containing two X chromosomes and no Y chromosome. This has been proved by a microscopic examination of the reproductive cells of the flies.

The importance of these experiments is that they show that X-rays may be used to upset the mechanism of heredity. In so doing they may permanently modify a reproductive cell so that it gives rise to a different kind of individual. There

is here no question of the inheritance of acquired characters since, in the first place, the X-rays appear to act directly on the reproductive cells and, in the second place, the modification of inheritance consists in a rearrangement of characters already present.

DISCOVERS LOST CITIES IN GUATEMALAN WILDS

Washington. Five Mayan cities, abandoned hundreds of years ago, have been discovered in the forests of Yucatan and Guatemala by Dr. Sylvanus G. Morley of the Carnegie Institution of Washington, who has just returned from an archaeological expedition in Central America.

The largest of these five cities was found in northern Guatemala. Dr. Morley calls it "Naachtun or Distant Stones" on account of its inaccessibility. It was once, he says, a large, fairly prosperous, provincial town which might be compared with some of our present day middle western cities.

Practically all that remains of the fragile private dwellings of the thousands of former inhabitants are the few stones which formed their kitchen fire places. Imagine, says Dr. Morley, the city of Washington with everything leveled to the ground except government buildings and churches and you get some idea of Naachtun as it now stands. Only public buildings and pyramids mark its former importance. Among these ruins some of the large pyramids are 90 feet high.

These pyramids should not be confused, he emphasizes, with Egyptian pyramids, which were used as tombs. The American pyramids were merely solid platforms on top of which temples were erected. These temples served as astronomical observatories as well as for the barbaric religious rites performed in them.

Naachtun and many other cities were probably abandoned during the sixth century after Christ. Naachtun, Dr. Morley says, was one of the second class city-states of this powerful people. Cities of much greater size and importance have been found in years past. He also recently found two other ancient ^{city} sites in northern Guatemala and two others in Yucatan.

AGRICULTURAL NEWS OF THE WEEKCROP'S FATE SEALED
BEFORE SEED PLANTED

Greeley, Colorado. Weather six months or more before the seed ^{crop} are planted probably determines the size of the potato/ in Colorado, according to Dr. H. G. MacMillan, pathologist of the Bureau of Plant Industry of the Department of Agriculture.

"Temperature and factors influencing temperature", he says, "appear to affect the potato yield in Colorado. A critical study of meteorological factors and potato production indicates that temperature for at least six months prior to planting is reflected in the condition of the crop and the yield. Summer temperatures have much less effect.

"No data is available over many years as to the nature and causes of the prevailing disease, but Fusarium blight probably has been the controlling factor in potato production in Colorado. The high temperature in certain years, showing an increase above the normal during the winter and spring months appears to cause the infection of the potato seed pieces or plants by Fusarium fungus, with a rapid increase in the quantity of disease.

"An estimate of the winter and spring temperatures, showing whether they are above or below normal would be of great benefit to the farmer in preparing his seed potatoes. In years of high winter and spring temperatures he should plant whole seed. The critical temperature for infection of the potato seed by Fusarium is about 14 degrees.

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PLANS TO DOUBLE SIZE
OF ALASKAN REINDEER

Washington. Uncle Sam may make two steaks grow where one steak grew before. According to Dr. E. W. Nelson, chief biologist of the U. S. Biological

Survey, arrangements are being made to begin in October the crossing of the reindeer with the native Alaskan caribou for the purpose of increasing the size of the antlered animals which are rapidly becoming a commercially important source of meat supply of the United States.

The reindeer at present raised by the Eskimo in great numbers is an imported animal which strips about 150 pounds, while the caribou, the wild native Alaskan variety of reindeer, strips about 300 pounds. It is planned to capture wild caribou bulls and place them on an island with herds of reindeer cows, and so breed-up the size of the reindeer.

It is estimated that there are now over 200,000 of these animals and that that they are rapidly increasing. Most of these are owned by the Eskimos, but in recent years white herders have begun raising reindeers for the market in the States. Biological Bureau experts figure that there is enough grazing land in Alaska to support approximately 4,000,000 reindeer and believe that the industry can be developed to a point where its annual yield will exceed in value that of the precious metals of the Territory and at the same time help to build up a more permanent population in Alaska.

A bill has been introduced in Congress by Senator Smoot of Utah, to further this development by giving the Secretary of Agriculture authority to lease or permit the use of certain lands for grazing purposes.

NATIONAL ENGINEERING MUSEUM PLANNED FOR WASHINGTON

Washington. A national engineering museum is planned here under the auspices of the Smithsonian Institution to record and preserve the material historical evidence of mechanical engineering progress in America. A movement started by the Ericsson Memorabilia Association is being pushed in cooperation with the American Society of Mechanical Engineers and other organizations to found permanent exhibits of marine, ordnance, industrial, aeronautical, and automotive material. A new building especially designed for the display of operative models and to furnish a complete demonstration of past and present mechanical development in this country is contemplated.

(A Chat on Science)

WE WANT WATER

By Dr. Edwin E. Slosson

This is the season of the year when we appreciate the fact that our bodily substance is mostly composed of water. Lucky for us that it is, for water is not only the most abundant, but the most even tempered of liquids. It is slowest to cool and, what is of more interest just now, it is slowest to heat. It is this thermal conservation of water, otherwise known as its specific heat, that keeps us going regardless of the weather. For we can only live within the narrow range of two degrees Fahrenheit, and it requires a delicate adjustment of the mechanism to maintain that temperature as we roam from the equator to the pole, or as the climates of these regions alternately roam over those of us who live in the north intemperate zone.

It is water that keeps all parts of the body at the same temperature in all weathers by circulation, and then in hot weather like this reduces the temperature by evaporation. So as a man on a pleasure excursion has to put a bill into his pocket from time to time to compensate for the sum imperceptibly evaporated in small change, so we require frequent invoices of water to keep up with the increasing retail outgo. The body in summer time is a steam engine, constantly taking advantage of the high rate of exchange between liquid and gas.

For water is twice blessed. It gives a blessing as it comes and as it goes. And the latter is the greater, though we are not so grateful for it. We appreciate the coolness of a glass of ice water, but it does us fifteen times as much good afterward as it escapes through a million pores. A cup of hot tea, also may cool us off, for it takes away with it in evaporation from the skin fifty times as much heat as it brought to us.

Water is really what is wanted, although we add various flavors, call it

by various names, and charge various prices for it. And it does not matter much what its initial temperature is, it will serve its purpose just the same. The only important thing is to get enough of it at all times, before meals, after meals, between meals and at meals. One can hardly get too much of it, but one usually gets too little.

The regulation of the strength of the various fluids of the body is as nicely adjusted as the equilibrium of temperature. But both are dependent upon an abundant supply of water. An excess can be easily disposed of but a deficiency upsets the machinery. A pound of water a day is about what the body can manufactureⁱⁿ its internal laboratory from the hydrogen of the food and the oxygen of the air, but this is not nearly enough to run it. The automobilist cools down his combustion cylinder by wrapping it with water and keeping this in rapid circulation. We also are propelled by an engine using food as fuel in much the same way and we use the same device to prevent overheating. But we have to evaporate the water to get the full cooling effect and this tends to dry us up, to make mummies of us, to leave us stranded for want of water.

Our thirst is thus the longing of the salt that is left behind for the water that has departed. It is a sort of homesickness, a longing for an ancestral habitat. For Venus Anadyomene is a verified myth. All life sprang from the sea. And the tide that ebbs and flows through our heart is composed of much the same elements as the ocean from which it was originally dipped.

URGES HANDLING HEALTH WITH GREATER CARE

Washington. Only 10.34 percent of our rural population are protected with a health service which even approaches adequacy," declares L. L. Lumsden, Surgeon of the United States Public Health Service, in a statistical summary of conditions which he claims are in the nature of a national calamity.

Only about 203 out of 3,065 counties, or equivalent divisions, in our 48 states are provided at this time with whole-time local health officers, the figures show. There has been a slight increase during the three year period covered in the compilation which indicates that rural communities are beginning to appreciate the value of reasonably adequate local health service.

NEWS OF THE STARSHow Do Giant Stars Start?

By Isabel M. Lewis,

U. S. Naval Observatory

That dark nebulae and clouds of dark obscuring matter dimming the light of stars beyond occur not only abundantly in the Milky Way but more or less extensively over the entire heavens is a comparatively recent discovery of Rev. J. G. Hagen, S. J. of the Vatican Observatory.

While re-observing the luminous nebulae in Dreyer's New General Catalogue for the purpose of estimating their brightness, Father Hagen chanced upon many of these dark nebulae and in the construction of his Atlas of Variable Stars he discovered many more. In the systematic and thorough survey of the heavens required in this work a comparison of each chart with the heavens was made at least five times in different months and years so the effects of atmospheric conditions were entirely eliminated. The following interesting facts were revealed as a result of these investigations:

Dark patches of non-luminous matter occur in more or less thickly clustered groups over the entire heavens forming what might be called a Nebular Way on either side of the Milky Way and far more extensive than the latter. Not only the existence but the form and outline of these dark groups are revealed by their dimming effect upon the light of stars lying beyond them.

The diffuse, or irregular luminous nebulae are found most commonly where these dark clouds are most prevalent and lie usually on the borders of the non-luminous nebulae.

The sky is freest from these dark clouds where stars form in clusters. This is in accord with Herschel's observations that the star clusters appear to sweep clear a way for themselves through the heavens.

A noticeable separation of very bright and very dark fields is often formed by rows of equally luminous and equally spaced stars which at times enclose in the form of a circle or oval a bright field lying against a dark nebulous background - an island of light in the Nebular Way.

Father Hagen's discovery of the universal distribution of dark cosmic clouds in space is most remarkable and valuable, and opens up a field for speculation as to the connection between these extensive non-luminous clouds and the luminous nebulae and stars. Are the luminous, diffuse nebulae, as some astronomers maintain, simply dark nebulae illuminated by the light of associated stars? In a few cases at least, such as the nebulae surrounding some of the Pleiades and Orion stars, this is known to be so.

There is an unmistakable association of many of the excessively hot and brilliant bluish-white stars with luminous nebulae. Yet it is a most significant fact that the giant red stars, which the brilliant researches of Dr. H. N. Russell placed unmistakably at the beginning of stellar evolution, never are found associated with either luminous or non-luminous nebulae. Where, then, do the nebulae enter in the evolutionary chain?

Since it has been discovered that the stars associated with nebulae are at the peak of stellar development and are the hottest of all the stars, it appears rather that the nebulae are the cooling products of the dissolution of many of the massive stars through the effects of radiation pressure rather than the stuff of which stars are being formed. As to the origin of the giant red stars, such as Betelgeuse and Antares, the astronomer is still without a clue.

NO PHYSICAL DANGER IN
CROSSING HUMAN RACES

Boston, Mass. - Crossing human races does not produce inferior physical types. According to Prof. W. E. Castle of Harvard University, after a series of experiments on animals under the auspices of the Carnegie Institution of Washington, good races are not made bad by mixing nor can bad races be made good by combination alone.

Mendel's fundamental law of inheritance shows that the individual is a complex of many characters independently inherited. An individual may inherit the color of his hair from one parent and the shape of his nose from the other parent, while in other features he is a blend between the two parents. Among animals, he says, it has been found that when races are crossed which differ in many characteristics, all possible combinations of these characteristics will occur in the second generation of cross-bred offspring. Applying this knowledge to the human race, some eminent scientists have thought it possible that when unlike races are crossed great variability will be found among the second and later generations, and that among the new combinations, such characteristics as long limbs combined with short bodies, big hearts in little chests, and intestines too long or too short to fit in the spaces provided for them, would be found.

"My experiments do not bear out such an assumption," says Prof. Castle.

"Crosses made between the largest and smallest known races of rabbits, one weighing three times as much as the other, produced cross breeds which were remarkably vigorous and prolific, intermediate in size between the two parent races and later generations showed no return to original size of the pure parent races.

"The inheritance of size depends on factors which are general; affecting all parts of the body. A rabbit of large weight also had long skull, long ears and long leg bones to match the great weight, and a rabbit with short ears was in-

variably of small general size, We may dismiss as groundless the fear that a mixed human race will necessarily contain physical features of unbalanced proportions.

"As a matter of fact some of the best human stocks have arisen as race mixtures. The tall Scotch, and the short stocky Welsh are relatively unmixed ingredients of the intermediate but not less successful English type."

NOSES 30 PERCENT EFFICIENT AT STRAINING DUSTY AIR

Boston. As filters of the dust flecked atmosphere, our noses are distinct failures, according to Dr. Alexander McAdie, professor of meteorology at Harvard University, who claims that seventy per cent of the impurities are not removed by transit through the respiratory passages.

Many medical men, he says, have taken it for granted that efficient straining of the air takes place in the nasal and mouth corridors, but tests by physicians show that purification does not take place during the in-and-out-the-body trip made by the air. A miner's lungs fill up in a hurry, and render him subject to all sorts of pulmonary diseases, he claims.

Pointing out that the mouth mask was helpful in fighting the flu, he expresses the hope that filtered air may be listed with good water, sterilized milk and insect screens as aids to disease reduction.

ROADS WILL STAR IN FILM EXHIBIT

Washington. Motion picture stars frequently take to the roads, by now the roads are taking to the movies. The U. S. Department of Agriculture has completed a series of films showing the construction and maintenance of gravel, macadam, asphalt, and other types of roads. It is claimed that this is the first time that any nation has undertaken so thorough a presentation of this subject through the medium of the motion picture.

MATHEMATICS BEATS GOOSE-BONE BUT OBSERVATION WINS IN WALK

Washington. Time and weather wait for no man. While he was using up pencils by the package and paper by the ream in a spare time effort to demonstrate that the weather may be computed by means of a mathematical equation, six weeks rolled by before J. F. Richardson, English meteorologist and mathematician, had figured out the weather for the day following the one on which he began his calculation, according to Edgar W. Woolard of the U. S. Weather Bureau who claims that the Englishman's book shows that meteorology has become an exact science. The method used, however, can not compete with Uncle Sam's system of gathering observations twice a day and basing the forecast on them.

"Temperature, pressure, humidity, wind, etc., of one day are substituted for various terms in an equation and worked out by the laws of mathematics. In order to keep up with the weather as it happens all over the globe," says Mr. Woolard, "several thousand expert calculators would be required and if they kept ahead of the weather they would have to work overtime or several thousand more would have to be put on to do the figuring. Theoretically it is an interesting method, practically it can not now be used to advantage."

WHAT IS THE EARTH LIKE INSIDE?

Washington. Old ideas in regard to the high heat on the unknown inside of the earth may have to be revised, if the inconclusive evidence adduced by temperature tests in 107 deep wells in the United States by Dr. C. E. Van Orstrand, physical geologist of the U.S. Geological Survey, should be confirmed by later investigations. According to this expert, the steady increase in temperature, so great that a miner could not live at a depth of one mile, appears to be less rapid a little beyond that depth. Combined with the fact that mathematicians have not yet found the law of distribution of temperature from the surface to the center of the earth, this makes uncertain the estimation of some scientists that the heat at the center is as high as 180,000 degrees Fahrenheit. Observations at a depth of about 7,500 feet have been taken, but Dr. Van Nostrand has not been able to carry his investigations further.

EDITORIAL

THE MEMORIALS OF SCIENCE

To statesmen and to soldiers, bronze tributes are erected. To pledge the friendship of nations, statues are exchanged. When a leader of government dies, impressive ceremonies are held. The legislative bodies cease functioning. Deep mourning drapes the country.

America has suffered the loss of the man who made the telephone come true. What an impressive and satisfactory memorial was erected to him within his lifetime! At least thirty-four million miles of copper telephone wires must conduct every minute the intimate, commercial and national messages of the nation. Nearly every one except Alexander Graham Bell had a telephone in his house. Suppose the great system of telephones suspended operation for days as our law making system does upon the death of someone high in governmental circles. It would amount to a national calamity. One brief minute of silence of millions of voices, electrically carried over his own invention, was the most impressive and most universal tribute that the American people could render to Alexander Graham Bell.

What more fitting memorials to scientists, inventors and engineers could be erected than those that they themselves design?

DO YOU KNOW THAT -

The geophone, an instrument used in the World War to detect earth and rock sounds made in the construction of military mines and tunnels, may be used in saving entombed miners.

Poison ivy takes on a beautiful reddish hue early in the autumn and is picked for ornamental purposes by some people -- once.

Spain's hydro-electric power plants have developed over 500,000 horsepower or just about one-tenth of the potential water power of that country.

The turtle's heart will beat for two or three days after the rest of the animal has been made into soup.

DO YOU KNOW THAT -

Maya Indians, whose civilization flourished in what is now Guatemala, made use of the zero in their numerical calculations 500 years before the Hindoos and 1000 years before Europeans.

The first discovery of a disease producing bacteria was made by the French pathologist, Davaine, in 1854 in a study of sheep anthrax.

The Department of Agriculture has just issued a circular which tells farmers how to tan their own hides.

Small pox is on the increase in the United States.

DO YOU KNOW THAT -

Passenger airplanes made in Holland and equipped with English motors are being operated by a German company over a distance of 780 miles between Konigsberg, East Germany and Moscow, Russia.

Work of the Prussian experiment station for the study of drinking water has been extended to include a study of gas and dust contamination of the air.

The power required to turn the crank of an ice cream freezer would be sufficient to light a good size city, if we could convert energy into light as economically as does the glow worm.

Shock from the electric cat-fish, found in tropical African rivers, will knock down a man and kill other fish.

DO YOU KNOW THAT -

Flowering and fruiting of most plants can be hastened or delayed almost at will be properly shortening or lengthening the daylight period through the use of dark rooms and artificial light.

Charles Darwin, famous evolutionist, was very delicate and considered his day's work done at noon.

Scientists believe that cave inhabiting spiders have little if any eyesight, but that they can readily recognize their mates through an acute sense of smell.

Uncovered bright tin furnace pipes are more efficient carriers of heated air than asbestos paper-covered pipes of the same sort.

DO YOU KNOW THAT -

The water ousel, a bird found in the Yosemite National Park, has been known to build its nest beneath a water fall, the parents diving through the spray with each morsel of food for their young.

Use of a small amount of the milk of the rubber tree in the manufacture of paper increases its strength, and improves its folding resistance and water-proof qualities.

Many French passenger automobiles are being equipped with the four wheel disc brake.

The inhabitants of Gomera, one of the Canary Islands, have a radio system all their own. By use of a system of whistling signals they can convey bits of news and information over considerable distances with great rapidity.

DO YOU KNOW THAT -

The hunting of whales with machine guns by airplane has been reported from the Philippines.

The French Senate has appropriated 2,000,000 francs for the celebration of the 100th anniversary of the birth of Louis Pasteur, the great bacteriologist.

Columbia University recently started the first teacher's training course in eye conservation in this country. Observation of classes of children with eye defects is part of the course.

-----in-the United States

The manufacture of carbon black/annually consumes 40,000,000 ,000 cubic feet of gas.

READING REFERENCES TO NEWS-LETTER ARTICLES

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FRAGMENTS OF SCIENCE

It appears that when an ant finds some food, such as a dead fly, it goes toward the nest and on the way meets others, which become much excited and in turn communicate the excitement to others. Then the original ant conducts her associates back toward the dead fly. Contrary to the observation of Bethé, these Tortugas ants do not follow the path of the original ant, but must be deliberately led by her back to the fly. The "finder" ant apparently has not only a fair sense of the general direction back to the fly, but of the distance as well, and having gone the right distance the swarm suddenly breaks up and reconnoiters in all directions, some of them finding the fly, while many go astray.-- Dr. Alfred G. Mayer, biologist at Tortugas, Fla., who recently died.