

at every ordinate, so as to provide the data for drawing what I will call, for brevity in reference, the "gustograph" record. That something in the way of truth has then been obtained appears from the reflection that a man who had the air acceleration under his control for a given five minutes and a gustograph or acceleration record for some previous five minutes, would be able to reproduce the gusty phenomena of the air for that previous five minutes by controlling the air acceleration according to the gustograph record. He would not, of course, necessarily reproduce the actual *wind* of the previous five minutes, unless he happened to start the five-minute reproduction with the right wind value, but that agrees entirely, I believe, with the distinction there is between gustiness and wind in connection with aircraft.

As regards the safe "flyability" of the air by aircraft, I hazard the guess that it may be found convenient to connect it with such a quantity as the *maximum* gust over a random minute run of the gustograph, or perhaps with the *average* gust over the same period.

The proposal Prof. McAdie mentions—using the exponent of an exponential equation as the measure of the sharpness of a gust—looks easier to apply in examining the influence of particular classes of gusts than in obtaining continuous records from instant to instant. For the latter purpose it is, I submit, desirable that the gust should be defined by instantaneous conditions, independently of knowledge of things at a finite time either before or after the given instant. I may, however, be misunderstanding the exponential proposal in this connection.

If principles like those I suggest found acceptance, the question of having standard gustograph instruments would soon be likely to arise; for graphical differentiation of anemograph records is tedious, and discouraging to progress. I think gustographs may be designed on two broad principles: in the first there is an anemometer in which the *rate of change* of the reading is continuously recorded, and in the second there is an arrangement of fans and flywheels with torque-recording couplings between.

I shall be very pleased if what I have written contributes to the discussion anything which needed, in any case, to be brought under consideration.

S. L. WALKDEN.

London, N., April 25.

The Preparation of "Blood Charcoal."

PURE "blood charcoal" is a reagent of considerable importance to the physiological chemist. It is not only required for the decolorisation of liquids, but also for selective adsorption in an important series of quantitative estimations of animal fluids.

My stock of Merck's blood charcoal is nearly exhausted, and I cannot obtain a supply of any home-made article that is suitable.

I should be most grateful if any of your readers could give me any information as to the method of preparation of blood charcoal, or the name of a firm that would be willing to manufacture and supply the article. Material as good as Merck's would command a ready sale at home as well as in America, where they have had to abandon rapid and accurate methods of analysis owing to the lack of the necessary charcoal. Folin states, in a recent number of the *Biochemical Journal*, that no other charcoal will adsorb creatinine. I have got perfect results with two other specimens of charcoal, but inquiry reveals the fact that both of them came originally from Germany. Surely our technical chemists can produce articles as good as those of the Germans. SYDNEY W. COLE.

Biochemical Laboratory, Cambridge, May 9.

NO. 2481, VOL. 99]

STUDIES IN GENETICS.¹

(1) PROF. CASTLE was fortunate enough to secure in Peru a number of specimens of a wild species of guinea-pig, *Cavia cutleri*, Bennett, which is the probable ancestor of the numerous domesticated races which have had their origin in that country and have been introduced elsewhere. He found that this wild species produced completely fertile hybrids when crossed with various races of domesticated guinea-pigs, and the results of the hybridising experiments go to show that all the domesticated colour-varieties have arisen from *C. cutleri* by loss-variation or loss-mutation. It does not follow, however, that wild species have arisen in this way, as some believe, for it is significant that the Brazilian wild species, *C. rufescens*, yields sterile hybrid males when crossed with the domesticated varieties, while similar crosses between *C. cutleri* and domesticated varieties yield completely fertile hybrids. One of the general results of Prof. Castle's hybridisation experiments is to confirm his previous conclusion that size inheritance is blending and does not mendelise. It is not denied, however, that in special cases mendelising factors may exist that affect size.

In another study Mr. Sewall Wright deals with the genetic factors determining coloration in guinea-pigs and with the conditions which may account for continuous series of variations. "Intermediates between varieties which mendelise regularly have been found to follow very definite modes of inheritance, which, however, are very different in different cases, and could not possibly be predicted *a priori*." He shows that a complex of the most varied causes may underlie an apparently simple continuous series of variations.

Of great interest, again, are the prolonged breeding experiments that Prof. Castle has made with hooded rats. It is shown that the factor for hooded colour pattern may vary in genetic value. There may be genotypic variation in grade as well as phenotypic fluctuation—a conclusion which brings us back to a familiar Darwinian doctrine. "Racial changes," Prof. Castle writes, "may be effected through selection by the isolation of genetic fluctuations, as well as by the isolation of mutations. Moreover, genetic fluctuation makes possible *progressive change* in a particular direction, repeated selection attaining results which it would be quite hopeless to seek by any other means." The study of the hooded rats, previously reported on by Castle and Philipps in 1914, has been carried through three or four additional generations. "The additional genera-

¹ (1) "Studies of Inheritance in Guinea-pigs and Rats." By W. E. Castle and Sewall Wright. Pp. 192+7 plates. Carnegie Institution of Washington, Publication No. 241 (1916).

(2) "Gonadectomy in relation to the Secondary Sexual Characters of some Domestic Birds." By H. D. Goodale. Pp. 52+7 plates. *Ibid.*, Publication No. 243 (1916).

(3) "The Jukes in 1915." By A. H. Estabrook. Pp. vii+85+26 charts. *Ibid.*, Publication No. 240 (1916).

(4) "Fecundity versus Civilisation: A Contribution to the Study of Over-population as the Cause of War and the Chief Obstacle to the Emancipation of Women. With Especial Reference to Germany." By Adelyne More. With an Introduction by Arnold Bennett. Pp. 52. (London: G. Allen and Unwin, Ltd., 1916.) Price 6d. net.

tions of selection show a continued progressive movement of the racial character in the direction of the selection, and indicate the existence of no natural limit to the progress which selection can make in changing the hooded character." Prof. Castle's experiments show that there has been over-hastiness in generalising from the results reached by Johannsen and others.

(2) The influence of the reproductive organs on the secondary sex-characters differs in different groups of animals. A male crab that has suffered parasitic castration puts on a number of feminine characters and develops a small ovary. In insects, on the other hand, the secondary sex-characters seem to be quite independent of the gonads. In male mammals the castration may not be followed by any marked peculiarity in the development of the secondary sex-characters, though some of them may remain in an arrested infantile condition. In the female mammal the removal of the ovaries has very little effect on the secondary sex-characters. What Mr. Goodale has shown in regard to female birds (ducks and hens) is just the opposite of what holds in mammals. If the ovary be completely removed the female puts on the secondary sex-characters of the male—sometimes with startling completeness. Some individuals, as the fine coloured plates show, become nearly perfect replicas of the male; others are imperfectly masculine. It is interesting to notice that the masculine characters induced on the ovariectomised female are always like those of the male of the same breed. With male birds the case is different. If the gonads be removed, the majority of the secondary sex-characters of the male develop, though a few may remain in an infantile condition. What have been sometimes called feminine characters in castrated or abnormal males almost always turn out to be juvenile characters. Another interesting general fact is that castrated drakes lose the power of developing the summer plumage.

In thinking of the results of this carefully worked-out piece of experimental investigation, we see clearly that the internal secretions of the gonads have a specific morphogenetic influence on growing or active cells of the body. As Mr. Goodale says, the secretions must be considered part of the influential environment of each cell. But the further question arises whether the secretion acts as a "modifier" affecting the factors of a feminine character so that the result in development is a masculine character; or whether the secretion acts as an "inhibitor" on one of two alternative groups of factors, respectively masculine and feminine, both present in the female's genetic constitution. Thus in the duck or hen the ovarian secretion inhibits the developmental expression of the masculine plumage; in the absence of the secretion the masculine features find expression. It is too soon to decide between these views; Mr. Goodale appears to incline to the former. It may be noticed incidentally that there is no conclusiveness in Mr. Goodale's argument against Darwin's theory of sexual selection.

"According to Darwin's theory the start was made from a dull-coloured monomorphic species, an assumption that is not in accord with the nature of the female as shown by castration, since the brilliant male colours are only suppressed in her. The only possible effect of selection, then, would be the uncovering of a condition already present. But, by hypothesis, this condition did not pre-exist." But it is impossible to argue from the constitution of a Rouen duck of 1916 to what may have been the constitution of the female of distant ancestral types, before masculine mutations—probably enough arising in male-producing gametes—began to be included in the common complement of hereditary factors, forming a contingent of characters that normally lie latent in female soil, and are normally patent in male soil.

(3) Nearly a century and a half ago there drifted into an isolated valley in Z county in the United States "a number of persons whose constitution did not fit them for participation in a highly organised society." Much of the original stock was unsound, and in the relaxation of a primitive environment many of their progeny went from bad to worse. Constant inbreeding accentuated the deterioration. In 1874 the close blood-relationship of a number of criminal types in the area referred to attracted the attention of Mr. R. L. Dugdale, an Englishman settled in New York, who was keenly interested in questions of social reform. In 1877 he published his well-known study, "The Jukes," in which he showed that a bad inheritance associated with deteriorative environmental conditions had resulted in a deplorable multiplication of criminality, harlotry, and pauperism. The names he used in his investigation were fictitious, but the chance discovery of his original manuscript has made it possible for Dr. A. H. Estabrook to follow the later history of the strains which Dugdale studied. Starting from five sisters 130 years ago, the Jukes have become 2094, of whom 1258 were living in 1915. "One-half of the Jukes were and are feeble-minded, mentally incapable of responding normally to the expectations of society, brought up under faulty environmental conditions which they consider normal, satisfied with the fulfilment of natural passions and desires, and with no ambitions or ideals in life. The other half, perhaps normal mentally and emotionally, has become socially adequate or inadequate, depending on the chance of the individual reaching or failing to reach an environment which would mould and stimulate his inherited social traits." It must be noted that some have become good citizens.

Dr. Estabrook's study shows that cousin-matings of defective stock result in defective offspring; that there is an hereditary factor in licentiousness; that pauperism indicates physical or mental weakness; that all the Juke criminals were feeble-minded; that penal institutions have little beneficial influence upon these; and that ameliorative environment has markedly improved

a certain number of the individual members of the stock. The investigator has worked with patience and carefulness; his most feasible practical suggestion is the permanent custodial care of the feeble-minded Jukes.

(4) In a clear and courageous essay Adelyne More points out the advantages of a deliberate reduction of the birth-rate. Only thus can women secure independence; it is the chief way of reducing infantile mortality; it is the only way by which struggling parents can attain economic security; it forms part of the prophylaxis against venereal disease; and it is the most effective way of ensuring the cessation of war. "An undue fecundity promotes international pugnacity of precisely the kind which was operative in bringing about the present war." In a slashing preface—admirable in its exposure of our Anglo-Saxon false shame—Mr. Arnold Bennett deals, somewhat too cavalierly, we think, with the hygienic, religious, political, and industrial arguments against the use of contraceptives. He does not consider the ethical difficulties—perhaps transitional, but already real enough—involved in being able at will to evade the natural consequences of sexual intercourse, nor the social difficulties involved in the unequal birth-rate in different sections of the community, and in the likelihood that birth-control would tend to be adopted most among thrifty, far-sighted, controlled, and "individuated" types, of whom a progressive nation wishes more, not fewer.

J. A. T.

ENGINEERING EXPERIMENT STATIONS.

A MEMORANDUM prepared for the Governor and the General Assembly of the State of Illinois, concerning the work of the College of Engineering and the Engineering Experiment Station of the University of Illinois, has lately reached us. It is partly a statement of the work of the college, which gives degrees to more than 200 engineering students annually, with photographs of some of the large engineering works executed under the direction of its graduates, and partly an appeal for a large extension of its buildings. It is pointed out that the growth of a State in population, wealth, and influence depends chiefly on its success in the development of engineering industries.

It is known that the "State universities" of the United States have engineering laboratories more largely staffed and more completely equipped than those in this country, and that they carry on research work very directly associated with industrial needs. Lately there has been a movement to develop these as "experiment stations." In the case of the Illinois University the control is vested in the heads of departments of the college; the ordinary equipment of the laboratory is used, but there are nine investigators devoted to research work and fourteen research fellows who give half-time to research. All results are published and 106 bulletins have been issued.

NO. 2481, VOL. 99]

In a short account of the more important researches carried on, it is stated that Prof. Talbot's tests of reinforced concrete have supplied information on which standard practice has been based. They are well known in this country. In the case of iron alloys, researches have been made with an electric furnace permitting melting *in vacuo*. These, it is claimed, have led to the production of iron alloys having magnetic properties far superior to anything hitherto known—for example, specimens with a permeability seven or eight times higher than any other alloy. A new law bearing on steam-engine practice has been discovered by Mr. Clayton, connecting the form of the indicator expansion curve with the quality of steam in the cylinder. This makes it possible to predict the economic performance of an engine from the evidence of the indicator diagram. Prof. Goodenough has deduced values of the constants for steam which, it is stated, give the means of calculating steam tables of far greater accuracy than any hitherto published. Prof. Parr has devised a new low-temperature process of carbonisation of the non-coking Illinois coal of great importance, with the advantage that valuable by-products are recovered.

The building programme put forward will involve an expenditure of nearly 1,000,000*l.* exclusive of land and equipment. In the last two years the expenditure of the college has been 152,000*l.*, and the budget for the next two years is 300,000*l.* Some account is given of the Massachusetts Institute of Technology, now incorporated with Harvard University, which has purchased land and erected buildings and provided equipment at a cost of 1,400,000*l.*

The most important experiment station in the United States is, no doubt, the Bureau of Standards—a Federal institution which has relations with many industries, and receives from the Government 125,000*l.* annually. A remarkable development is the Mellon Institute attached to the University of Pittsburgh. There any industry can endow a fellowship for a specific research. The University selects a suitable investigator and provides the laboratory. When results are obtained a small unit factory is established near the institute and the process worked on a small but commercial scale. The annual expenditure is 30,000*l.*

PROF. EMIL VON BEHRING.

IN NATURE of April 26 a short chronological survey was given of the career of Emil von Behring, whose death was recently announced. In the early eighties of last century, whilst a military surgeon at Bonn, Behring commenced a series of investigations which ultimately led him to the discovery of anti-toxins. This work merits fuller notice than could be given to it within the limits of a paragraph in the Notes columns of NATURE.

The fact that white rats were generally immune against anthrax, whereas ordinary wild