and by every means and device which science offers. We shall need organization, we shall need team work, we shall need the resources of business-like methods and of competent leadership; we shall require the help of every art and science; and to some of them, especially to medicine, we shall count ourselves happy if in God's good time we can bring something in return. But more than all things we shall need, indeed we must insist on retaining, freedom; liberty to research on things because they are of interest, because their study and investigation are an adventure of the human spirit, because they would seem to lead towards a solution of those fundamental problems which man, in his intellectual impudence, believes to be soluble.

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ON THE CONTROL OF THE RAT POPULATION

ASSUMING that one pair of wild Norway rats begins to breed at four months of age and produces four litters at intervals of four months between litters, and that each litter consists of six young—three males and three females—and further assuming that all the pairs of young breed in a like manner through successive generations, Professor George Gailey Chambers, of the University of Pennsylvania, has computed that at the end of ten years from the birth of the original pair, the progeny would be represented, approximately, by the number 2.3×10^{18}. This is 2.3 times one million to the third power—a number itself well-nigh incomprehensible, though amusing to play with.

If, under the same conditions computation is again made—but this time only for three years—it appears that at the end of three years there would be some 516,000 individuals. Thus, while there were two rats at the beginning of the period, there would be at the end, over 500,000, and this in three years. Such results serve to show how rapid the increase might be.[1] For obvious reasons these computations, which purposely exclude all consideration of postnatal mortality, can not be controlled by direct observations.

Bearing on these computed results, there are, however, some laboratory records which are illuminating. In 1919 Miss Duhring, who is in charge of the albino rat colony at the Wistar Institute, obtained, in 16 months from the birth of the original pair, 3,800 individuals, all the descendants of one pair of albino rats. Moreover, this result was obtained, although after the first litter of the original pair—the pairs were not mated until they were four months of age and in the later months of the period—several hundred rats were not allowed to breed at all owing to lack of cage room.

Under the conditions given for our first instance only 512 Norway descendants were to be expected at the end of the first 16 months. These observations on the albino variety show, therefore, that the conditions set for the computation in the case of the Norway are conservative, since direct observation here gives a number of albinos more than seven times that computed for the Norway.

The high numbers for the albino rat were the result of large numbers of litters from a single pair: a shortening of the time between litters, frequently to 30 days or less—and large litters—many containing 15 or more individuals. The mortality was, of course, very low. The causes for these conditions leading to rapid increase were good food, the absence of external parasites; careful handling and some exercise in the revolving wheel. Among these influences the absence of parasites and the good food are of special importance.

We may estimate the rat population of the United States at present as 120 millions. This estimate is admittedly liberal.

Under the conditions given for our first instance this number, 120 millions, would be somewhat surpassed by the progeny of one pair in four years and four months.

The Norway rat has been in the United States for at least 150 years and since, after this long lapse of time, it is estimated to number only 120 millions, it has clearly failed to live up to its reproductive potentiality as computed, for to obtain 120 millions from one pair in 150 years would require doubling the population only every 5.8 years.

To explain this slow rate of increase as compared with that to be expected from the foregoing computations we must choose between a very high postnatal mortality and a greatly restricted reproduction. Without presenting a detailed argument we can, I think, fairly conclude that the difference depends mainly on the restricted reproduction. Under the conditions in which the wild Norway usually lives, the enormous numbers, as computed, are never born.

As recent laboratory studies show, it is by food that the rate of reproduction is largely controlled. Where suitable food is plentiful reproduction is active—a relation illustrated by the abundance of rats about granaries, slaughter houses, on the water front of

[1] Previous calculations of the reproductive powers of the rat—some of which give enormous numbers—are presented by James Silver, on page 66 of the *Journal of Mammalogy*, Vol. 5, No. 1, February, 1924.

seaports and recently in the trenches, as we shall long remember. The population in these localities is largely indigenous.

The present methods of control involve the organized killing of rats. Rat battues may, in a measure, remove rats from the selected localities, but killing a large fraction of the rat population in a given place increases the proportion of food available for the survivors and the albinos show what survivors can do when well fed.

In the view of the public interest in the reduction of the rat population I have ventured briefly to call attention to the relation of the food supply to the general problem, since a recognition of the relation will assist in making plans for the effective control of this animal.

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SCIENTIFIC EVENTS

THE SOUTHAMPTON MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ARRANGEMENTS are in progress for the next annual meeting of the British Association, to be held in Southampton from August 26 to September 2, under the presidency of Dr. Horace Lamb, formerly professor of mathematics in the University of Manchester. Presidents of the several sections have been appointed as follows: *mathematics and physics,* Dr. G. C. Simpson, director of the Meteorological Office; *chemistry,* Dr. C. H. Desch, professor of metallurgy in the University of Sheffield; *geology,* Professor W. A. Parks, of the University of Toronto; *zoology,* Mr. C. Tate Regan, keeper of zoology in the British Museum (Natural History); *geography,* Mr. A. R. Hinks, secretary of the Royal Geographical Society; *economics,* Miss Lynda Grier, principal of Lady Margaret Hall, Oxford; *engineering,* Sir Archibald Denny; *anthropology,* Dr. Thomas Ashby, director of the British School at Rome; *physiology,* Dr. A. V. Hill, professor of physiology in University College, London; *psychology,* Dr. C. E. Spearman, Grote professor of the philosophy of mind, University of London; *botany,* Professor J. Lloyd Williams, of University College, Aberystwyth; *education,* Dr. W. W. Vaughan, headmaster of Rugby; *agriculture,* Dr. J. B. Orr, head of the Rowett Research Institute, Aberdeen. Among the principal items already set down for discussion are transport problems, to which the sections of economics and engineering will devote two days, with special reference to the railway centenary of the present year; the cost of farming and the marketing of agricultural produce (sections of economics and agriculture); the functional significance of size (zoology and physiology); the ignition of gases (chemistry and engineering); tidal lands (geography and botany); variations in gravitational force and direction (physics and geology); recent investigations upon vocational guidance (psychology and education); the distribution of animals and plants in relation to continental movements (geology, zoology and geography); the acquisition of muscular skill (physiology and psychology), and discussions on health in schools, the disciplinary value of subjects, the training of teachers and the teaching of biology. Professor Parks, of Toronto, as president of the geological section, succeeds the late Dr. Willet G. Miller, the Ontario government mineralogist, who was to have occupied the chair of the section.

LEGISLATION RELATING TO THE SCIENTIFIC WORK OF THE GOVERNMENT

A BILL providing for a medal of honor and awards to government employes for distinguished work in science, the plan for which was originated some time ago by Dr. E. Lester Jones, director of the United States Coast and Geodetic Survey, was introduced into the house of representatives on February 19. The bill, which follows, was referred to the committee on the library:

Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that the president of the United States is hereby authorized to present, in the name of congress, a medal of honor and written testimonial to scientific workers of the federal government whose labors have contributed to the advancement of scientific knowledge or applied its truths in a practical way for the welfare of the human race.

SECTION 2. The official designation of the medal shall be the Jefferson Medal of Honor for Distinguished Work in Science.

SECTION 3. That recommendations to the president of persons to be considered for the honor contemplated in this act shall be made by a commission of three persons, consisting of one representative each from the National Academy of Sciences, the American Association for the Advancement of Sciences and the American Engineering Council, who shall serve without salary.

SECTION 4. That not more than five scientific workers shall receive the medal in any one year and that the persons so honored shall receive the sum of $100 on the presentation of the medal and testimonial and thereafter, annually for life, a sum of money the amount of which shall be fixed by the commission making the award; said sum to be not less than $100 and not more than $500 per annum, which said sum shall be exclusive of salary or pension.

SECTION 5. There is hereby authorized an appropriation of $1,500 to defray the expenses of securing a suit-