that the approach of an attracted mass towards an attracting centre is accompanied by a rise in temperature, or, for the approach to be isothermal, heat must be taken away from the approaching mass.

Let us suppose a mass m grams is attracted with a force F dynes by an attracting mass M grams at a distance r cm. On an F,r diagram draw the Carnot cycle ABCD, AB and CD being isothermals at absolute temperatures θ and $(\theta-\delta\theta)$ respectively, BC and DA being adiabatic changes in the distance between the attracting centres. Take the mass m round the cycle. Let the heat supplied along AB be $m.\delta Q$ ergs, where δQ is the heat required to keep the temperature of 1 gm. constant when the distance changes from r to $r+\delta r$.

By the second law of thermodynamics the work done in the cycle is $m.\delta Q.\frac{\delta\theta}{\theta}$ ergs. The work is also given by the area ABCD, *i.e.* $\left(\frac{dF}{d\theta}\right)_{r\text{ const.}} \times \delta\theta \times \delta r$ ergs.

Hence $$m.\delta Q=\theta\left(\frac{dF}{d\theta}\right)_r.\delta r,$$

which means that

$$m\frac{\partial Q}{\partial r}=\theta\frac{\partial F}{\partial\theta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Let the Newtonian law hold for isothermal changes in the distance between the attracting centres, then

$$\frac{\partial F}{\partial r}=-\frac{2GMm}{r^3} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Also, if s is the specific heat of m in ergs we have for r constant

$$\frac{\partial Q}{\partial\theta}=s \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

From (3) we get

$$\frac{\partial^2 Q}{\partial r.\partial\theta}=0.$$

From (1) we get

$$\frac{\partial}{\partial\theta}\left(\frac{\theta}{m}\cdot\frac{\partial F}{\partial\theta}\right)=\frac{\partial^2 Q}{\partial r.\partial\theta}=0,$$

$$\therefore \frac{\theta}{m}\frac{\partial F}{\partial\theta}=f(r),$$

whence $$F=m.f(r).\log\theta+\phi(r).$$

Putting this in (2) gives

$$m.f'(r).\log\theta+\phi'(r)=-\frac{2GMm}{r^3}.$$

This requires that

$$f'(r)=0, \text{ and } \phi'(r)=-\frac{2GMm}{r^3}.$$

Hence $$f(r)=A \text{ and } \phi(r)=G\frac{Mm}{r^2},$$

which give $$F=G\frac{Mm}{r^2}+A.m.\log\theta,$$

i.e. the greater the mass the temperature of which is raised, the greater the correction due to temperature.

If the force of attraction between two masses at constant distance is F_1 when one of them is at a temperature of θ_1, and F_2 when that same one is at θ_2, then, other things being constant, we have

$$F_2-F_1=A.m.\log\frac{\theta_2}{\theta_1},$$

where m is the mass the temperature of which is raised.

Calculating A from Dr. Shaw's results gives the approximate value of $1{\cdot}4\times10^{-12}$. Poynting and Phillips (Proc. Roy. Soc., A 76) used 208 grams attracted by the earth and the temperature was varied between $-186°$ C. and $+100°$ C. Hence the change in the attracting force would be

$$A.m.\log\frac{\theta_2}{\theta_1}=1{\cdot}4\times10^{-12}\times208\times\log_e\frac{373}{87} \text{ dynes}$$
$$=4\times10^{-10},$$

or a change of 1 in 5×10^{14}, which Poynting and Phillips could not possibly detect.

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DESTRUCTIVE WILD BIRDS.

ONE of the evidences of the awakening in the public mind to the importance of the subject of the status of wild birds in relation to agriculture, horticulture, forestry, and fisheries is the annual newspaper correspondence. The subject has been dealt with year by year in a large number of papers, from the *Times* to the local village weekly. Unfortunately the attitude assumed by the majority of the correspondents is one based largely upon want of knowledge and a misconception of the subject under discussion. Whilst one section of writers presupposes that the majority of wild birds are distinctly injurious and should be ruthlessly destroyed, the other regards all birds as beneficial and advocates stringent measures for their protection. Such extreme views are both wrong and retard rather than aid a true understanding of a most complicated, but all-important, subject.

At a time when it is almost imperative that the land should be made to produce its maximum yield, it is doubly important that any factor that acts as a deterrent should be better understood and receive more than passing attention. The vexed question of the economic status of our wild birds is indeed a matter that calls for a very thorough, exhaustive, and continued inquiry.

From the first class of writers mentioned above one would conclude that little or no trustworthy evidence is forthcoming, and that we possess no exact knowledge of the feeding habits of any wild birds, the changes in feeding habits, their relation to the destruction and distribution of weeds, etc. Such, however, is far from the truth. Whilst, unfortunately, we have no State department or organisation engaged upon an investigation of the subject, tabulating records and results year by year, and spreading the information thus obtained amongst the people most interested, for more than thirty years there has been a small but enthusiastic number of private workers whose cumulative work has provided us with a most valuable mass of facts and original observations, and, thanks to these workers, it is now possible to state definitely that at the present time there is ample evidence of a far-reaching kind to prove :—

(i.) That no quarter should be shown to the wood-pigeon, which is one of the most destructive birds with which the agriculturist is confronted, and that every means should be taken to destroy it.

(ii.) The results of an investigation carried out by the writer in 1907–8–9 upon the feeding

habits of the rook, supplemented by similar work by Thring, Florence, and Hammond, clearly go to prove that this bird is far too plentiful at the present time, that it prefers a grain diet, and that it is injurious.

(iii.) In a like manner it has been shown that the starling has increased in numbers enormously during the last twelve years, and so long as these numbers are maintained this bird must prove a source of considerable loss to the farmer.

(iv.) The bullfinch and the blackbird in fruit-growing districts are most destructive, and cause great losses to growers. Both species demand drastic measures for their reduction.

Further instances might be quoted, but the above will suffice to show that definite and indisputable evidence can be obtained with reference to the feeding habits of any particular species of wild bird.

If the results obtained in investigations of this kind are to be of any practical value the evidence must be thorough and overwhelming. Elsewhere [1] I have set forth in detail the procedure that is necessary in order to obtain this information, and nothing short of the greatest thoroughness and accuracy can lay claim to thoughtful consideration.

The statement is frequently made that notwithstanding a little harm that certain birds occasionally do at particular seasons of the year, as a class they are beneficial. If this be so, it seems to me most important that we should know which species are the culprits, the extent of the damage or loss they occasion, and the frequency with which they occur throughout the country, in order that so beneficial a class of animals should be rid of their "black sheep," and their fair repute remain impeccable.

Unfortunately such a statement is only partly true, and in the present state of our knowledge it cannot be denied or upheld upon practical evidence. This, at least, we do know: that many species of wild birds are protected that are distinctly injurious, in consequence of which hundreds of thousands of pounds' worth of food is annually destroyed by them; that there are many species of wild birds which are annually destroyed in large numbers, and that the food of these species has been proved to consist almost entirely of farm vermin, which latter exact an enormous toll upon the produce of the land; finally, that there are a number of species with reference to which we know comparatively very little as regards the nature of their food and feeding habits, and before they can be said to be beneficial, injurious, or neutral, much more detailed information is required.

At the present time farmers and fruit-growers throughout the land are indiscriminately destroying wild birds, so that a recent writer states: "Some of the very greatest friends that our nation has are being destroyed without mercy. . . . If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

The hands of our legislators are tied, for, as I have elsewhere stated,[2] "the need of continued investigation upon a subject so intimately related to our food supply must be patent to even the most casual inquirer, for without a thoroughly reliable and extensive knowledge of the subject it is impossible to frame wise and beneficial laws relating thereto."

Hitherto the State has not thought the subject worthy of serious attention (if it has acted it has done so too late or inefficiently), but the exigencies of the present abnormal times may compel it to do so, and to rue that it has been so apathetic and neglectful of the subject in the past.

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[1] Journ. Roy. Hort. Soc., 1917, xlii., part 1; and more briefly in NATURE, January 7, 1915.

NEW ANTISEPTICS.

NOT the least important feature of the present war is the interest which has been concentrated on the effective treatment of septic wounds. Attention has already been directed (NATURE, February 10, 1916) to the use of the hypochlorite solutions of Dakin and Lorraine Smith, and to that of chloramine-T of Dakin, Cohen, Daufresne, and Kenyon. These substances, whilst they possess strong bactericidal properties, have little or no irritant or toxic action in antiseptic strength, and have in consequence found very general and successful application. The latest contribution to the subject, by Messrs. Browning, Kennaway, and Thornton, and Miss Gulbrausen, of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, is embodied in a report to the Medical Research Committee. It was published in the *British Medical Journal* of January 20; and the daily papers have lately devoted attention to the subject.

The defects of most antiseptics lie in the fact that, whilst they act chemically on proteins and so destroy bacteria, they also affect the serum, which has itself powerful antiseptic properties. This probably explains the large reduction in bactericidal action of most antiseptics in presence of serum. Furthermore, most antiseptics inhibit phagocytosis and so deprive the body of one of its most important weapons in combating local infection. An ideal antiseptic should therefore combine powerful bactericidal action along with the absence of deleterious effect on phagocytosis or on the nature of the serum. It should further be without irritant or toxic action, whilst stimulating healthy granulation.

Among the substances which the authors have examined are a number of triphenylmethane dyes (malachite green, brilliant green, crystal violet, and ethyl violet) and the yellow colouring matter

[2] Journ. Roy. Hort. Soc., 1917, xlii., part 1.