eroded, and when this is done we find that the process has not continued regularly for an indefinite period, but began, as now manifested, only some 3000 or 4000 years ago. In Neolithic times, according to evidence supplied by buried land surfaces, the sea stood 60 feet lower relatively to the land, and on the south and east coasts of England the rising downs were separated from the coasts by a wide plain. About 4000 years ago there set in a rapid but intermittent subsidence of the land or rise of the sea, on the completion of which the coast erosion now in operation began. In course of time shingle beaches and sand dunes were formed from the eroded material, and supply the best protection against further inroads. Much valuable alluvial land has also been formed in sheltered estuaries, so that it is an important question whether the net gain from protective works (if existent at all) would justify the enormous outlay involved. In the discussion which followed (in which Prof. Percy Kendall, Mr. Whitaker, Mr. E. R. Matthews, and others took part) the need of taking a broad view of the whole question was again and again emphasised, instances being given of the detrimental results of uncoordinated protective operations. Mr. Matthews, an engineer from Bridlington, gave some instructive details as to recent changes on the Yorkshire coast.

The geodetic discussion was opened by Major E. H. Hills, who pointed out that though the fundamental triangulation of these islands was excellent work for the time at which it was done, it is now far behind the standard of modern work of its class. This is the more regrettable, inasmuch as it prevents the coordination of British with Continental work, although the necessary observations to connect the two series have actually been made, and such coordination is of high importance in connection with questions such as the determination of the figure of the earth. All that is absolutely necessary is to connect geodetically, by as good a set of triangles as possible, the extreme points of our islands, and, were this done, amplitudes of 10° and 11½° respectively would be added to two very important geodetic lines, viz. the meridional arc through the Greenwich meridian and the longitudinal arc along 52° N., which at present extend through 18° and 57°. Major Hills's proposals were warmly supported by Colonel D. A. Johnston (who presided at the discussion), Prof. H. H. Turner, Major Close (who mentioned as a less ambitious scheme the measurement of the central meridian of England running north from Southampton), Colonel Hellard, director of the Ordnance Survey, and others, the small cost of the undertaking and the reproach to British science involved in the existing state of things being generally insisted on. At the close of the discussion Mr. E. A. Reeves described a new form of range-finder invented by him, which, though at present in an experimental stage only, gives promise of proving of great use in survey work as well as, possibly, for military purposes.

Several of the papers described the scientific results of recent expeditions. Mr. J. Stanley Gardiner, besides presenting the report on the general work of the Percy Sladen expedition in the Indian Ocean, described the Chagos Archipelago in detail, discussing the coral formations and touching also on the life conditions, especially of the vegetation. He showed that there was evidence here, as throughout the Indo-Pacific coral-reef region, of a relative rise in the land-level reaching from 5 feet to 35 feet, and probably due in great part to a withdrawal of water from the equator by the piling up of ice in the Antarctic. The atolls seem to have been formed on submerged shoals by coral and nullipore growth on the edges of the latter, and the lagoons show a progressive increase in depth and area through solution, boring and triturating organisms, and tides. Mr. R. N. Rudmose Brown described the South Orkneys and other localities in which scientific collections had been made by the Scottish Antarctic Expedition; Mr. J. Parkinson gave an outline of the physical structure of southern Nigeria—a subject on which little has hitherto been known—from observations during a mineral survey of the region under the auspices of the Imperial Institute; and Mr. James Murray sketched the general scientific results of the survey of the Scottish lochs, discussing in particular the "internal seiche" which has been brought to light, and was explained as occurring on the cessation of a gale which had maintained a temporary equilibrium between two bodies of water of different densities separated by an oblique line of separation.

Two papers dealt with the economic side of geography. That by Major Beacom, of the United States Legation, gave a most interesting account of the vast irrigation projects inaugurated within the past few years by the United States Government, enlarging in particular upon the Colorado River as the American Nile, and the changes in the Colorado desert due to irrigation. Prof. L. W. Lyde spoke of the wheat area in central Canada, showing how the climatic conditions favour the growth of that crop, especially along a line through Brandon and Battleford. He expressed a high opinion of the probable output of wheat from this area in the immediate future, but held that wheat growing was here eminently the work of the small farmer.

At the afternoon meetings illustrated lectures appealing to a more general audience than some of the above were given. Prof. W. M. Ramsay gave an instructive account of the past and present of Asiatic Turkey as influenced by physical conditions, tracing the fortunes of the region through their various vicissitudes, and forecasting a prosperous future from the advent of railway communication. Major P. M. Sykes described a tour in south-east Persia, dwelling on the many interesting historical associations and speaking of the ruined cities of the Narmáshir district. Mr. Yule Oldham interested a large audience with an account of the visit of the association to South Africa in 1905, while, lastly, Mr. Trevor-Battye showed a striking series of views illustrative of life and nature on the Zambezi above the falls, which he ascended at the close of the same visit of the association.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

SEVERAL subjects of great practical importance were discussed at the Physiological Section of the British Association; so much was this the case that the section proved to be the resort of larger audiences than formerly, and before the end of the week the building placed at the disposal of Section I was all too small for its purpose.

Of the discussions, none was more appropriate to York than that introduced by Dr. F. Gowland Hopkins on the minimum proteid value in diet. This question has two aspects, the physiological and the sociological; the former was the subject of extended researches some time back under the guidance of Prof. Atwater and Dr. Benedict, and more recently under the very able superintendence of Prof. Chittenden at Yale. It is, however, the sociological aspect of the question which gives it an especial interest in York, for in that city, as is very generally known, Mr. B. Seebohm Rowntree has made a very laborious and complete investigation of the dietetic conditions which obtain amongst the poorer classes, and has convinced himself that about one-quarter of the whole population is insufficiently fed. The value of his research depends essentially upon a correct judgment as to the minimum diet upon which a labouring man can perform an efficient day's work. The sociologist is therefore dependent upon the physiologist for his fundamental data.

The physiological requirements of the body are twofold—requirements of matter and requirements of energy; the necessary carbon and nitrogen must be provided, and they must be provided in a form which yields the number of calories equivalent to the energy dissipated by the human organism as work and heat. The subject was greatly simplified by Dr. Hopkins, for he showed that as the practical outcome of a large number of researches the energy value of the food might be almost disregarded. "It always worked out," he said, "that if the nitrogen-value of the food was looked after the calorie-value would look after itself." Very different views obtain as to the minimum nitrogen value of a daily ration, and the disparity of view has been much increased within the last five years. We used to think that 100 grams of proteid food per day, giving 15 grams of nitrogen, was a somewhat restricted diet. Prof. Atwater has raised this figure considerably, whilst Prof. Chittenden has reduced it. Facilities have

been given to Prof. Chittenden and his colleagues by the American Government, and they have studied, not only themselves, but athletes in training and squads of soldiers, and have constantly found that by gradually accustoming these men to a carbohydrate diet a condition of physical efficiency and nitrogenous equilibrium can be obtained, though with some loss of weight. As the result of this gradual process the proteid might be reduced until only about 7 grams or 8 grams of nitrogen were excreted daily.

Actual figures of nitrogenous output were given by Dr. J. M. Hamill and Mr. E. P. Poulton; the former with Dr. Schryver has investigated the nitrogenous output of the workers in the physiological laboratory of University College, London; the latter has experimented upon an Oxford student, *aet.* twenty-two, while he was going through the ordinary routine of university life at Oxford. There was great disparity amongst their figures. The workers at University College varied from 8 grams to 16 grams of nitrogen daily, whilst Mr. Poulton's figure was a high one.

The low nitrogen values indicated above are of great scientific interest, but from the practical point of view they were shown to be of rather academic value by Dr. Hopkins. He made it quite clear that the observers who had obtained these values for the daily nitrogen output had done so on diets which were many times more expensive than those to which the working classes had access. He showed, in fact, that such food as a working man could buy must have a nitrogen value and a calorie value which was of the order indicated by Voit. The point at issue, then, between Dr. Hopkins and Mr. Rowntree was whether the moderate diet indicated by Voit or the more considerable one indicated by Atwater was to be taken as the basis of a proper daily allowance for the working classes. Now though there is a considerable difference between these two diets it is clear that there are lines along which a solution may be forthcoming. Three such directions were indicated by Dr. Hopkins:—

(1) More searching analyses must be made into the nature of foodstuffs (and this point was developed by Prof. Armstrong). Maize, for instance, is particularly unsuitable as a staple dietary, not because it is of insufficient nitrogen value or even of insufficient calorie value, but because a particular kind of proteid, which is necessary to growth, is conspicuously absent from maize.

(2) The relative values of the various tissues as energy transformers must be attested. This work is being carried on by a committee of the British Association, and its annual reports for the past three years have been very instructive, but only the fringe of this large subject has been touched.

(3) Conditions of age and sex have not been thoroughly investigated. It seems clear that a developing individual—say of twenty years—requires a richer diet than a man of twice that age.

Dr. Hopkins readily conceded that even the trained athlete or the soldier might transform much less energy than was entailed in the daily toil of a bricklayer or a rivetter, and in view of this uncertainty we have some sympathy with Mr. Rowntree's contention that the calorie value demanded by Atwater, if acquired in the form of bad food eaten amid unappetising surroundings, was none too much for a heavy day's work.

Another discussion of great interest, entitled "The Physiological Value of Rest," was introduced by Dr. Theodore Dyke Acland and Dr. Bevan Lewis. The former dealt chiefly with the hours of rest prescribed in the large public schools of this country. His views are so well known that it is not necessary to give them at length. The discussion was useful from several points of view, which may be briefly summarised:—

(1) The necessity of obtaining scientific data concerning fatigue phenomena. This matter was dealt with by several of the pioneers in that branch of physiology, namely, psychophysics, which is rapidly springing up, and which bids fair to yield far-reaching results. Dr. Rivers, Prof. McDougall, and Dr. Myers indicated how the question might be approached on strictly scientific lines.

(2) The necessity for limiting the prevalent idea that "recreation is a change of occupation." This dictum is useful and true so long as occupation does not amount to fatigue, but its utility ends at this point. When the system becomes fatigued, and this is especially true of the brain, the toxic bodies produced affect unused as well as used cells. It is futile to throw these cells, already prejudiced, into activity. Such action simply adds to the amount of poisonous or toxic bodies in the circulation. This point was worked out with great clearness by Dr. Bevan Lewis, whose introductory address was on very different lines from that of Dr. Acland. Dr. Lewis treated the subject from a neurological, not a statistical, standpoint; he opened with a defence of the "neuron theory," now assailed from so many quarters, and on this theory worked out a conception of the neurological basis of rest and of fatigue. The practical outcome of his argument, as well as of Dr. Acland's, was that physical exercise was no substitute for sleep, but that active physical exertion added to severe mental strain demanded a double meed of slumber. In illustration of this point Dr. Acland recounted how that Mr. C. B. Fry, at once a scholar and an athlete, frequently slept till midday or even late in the afternoon during his school vacations, and in doing so gratified nothing more than the healthy demand of his frame—physical and mental—for rest.

(3) This discussion made clear the individual differences in the depth and time of slumber; thus day workers attain the maximum soundness of sleep early in the night, whilst night workers begin their slumber by sleeping somewhat lightly and sleep more soundly as morning approaches. Neurotic subjects, on the other hand, have two maxima on their sleep curve, one in the early part of the night, another in the morning; between these there is a period of shallow sleep. If any occurrence happens which causes a general reduction in depth of slumber, the period of shallow sleep in the middle of the night is replaced by a period of wakefulness.

(4) Prof. Gotch, who showed the utmost skill in weaving the separate items of this discussion into a continuum, dwelt upon the nature of dreams as an index of the soundness of sleep. If a dream was a connected series of events and was recollected as such after waking, it was clear that the mental rest was impaired. The more coherent and the more realistic the dream, and the more directly it was concerned with events in the recent past, the less restful was the sleep in which it occurred. The quality as well as the quantity of the sleep was all-important.

The sitting of Friday morning, August 3, was devoted to a paper on public health. Dr. George Reid, the medical officer of health for Staffordshire, put forward a number of telling arguments, the result of experiments which he had performed, in favour of changing the form of many sewage filters. It appears that the chemical changes which take place in a filter of fine particles are completed relatively near the surface. Dr. Reid advocates the use of one-eighth inch particles, and of filters only about 4 feet deep. Such filters would be much less expensive than those now in use. A detailed account of his investigations was recently published by the Royal Society.

Dr. Hime, of Bradford, brought forward a strong indictment of the present system of reporting and isolating infectious diseases. His data were collected from twenty-five large towns in the United Kingdom, and dealt with diphtheria, scarlatina, and typhoid, which taken together formed 95 per cent. of the cases reported. His general argument was that the epidemics of these diseases had increased in virulence and number within recent years in spite of the present system. The most telling figures which he adduced were from cases where the hospitals had been closed to one or other of these complaints and the cases sent back to their homes. On one such occasion more than ninety cases of scarlatina were sent back to the poor neighbourhoods of a town. No epidemic followed; in fact, the epidemic which was prevalent ceased at once.

The discussion which followed Dr. Hime's paper turned rather upon a matter of principle. Granted that experts were in doubt concerning the present system of reporting and isolating cases, was it wise to make the matter one of public discussion? Some medical officers held that such debate weakened the trust in the public authority, and introduced an element of personal option as to whether

it should be obeyed. The view more generally taken was that, since the civic control was becoming daily more vested in the popular vote, it was desirable for the British Association to emphasise the responsibility which rested upon the public to acquaint themselves with matters connected with the public health, and to put the most trustworthy information before them in the most open way.

Amongst the more technical communications there were two excellent ones by Drs. Nasmith and Graham, of Toronto, on the hæmatology of carbon monoxide poisoning, and by Dr. Dawson Turner on the electrical resistance of the tissues. Both communications were the result of much laborious research; their interest lay along the more strictly medical line.

JOSEPH BARCROFT.

LOCAL SOCIETIES AT THE BRITISH ASSOCIATION.

THIS conference was presided over by Sir Edward Brabrook, C.B., who fitly represented those societies which have recently been brought into relationship with the British Association under the title of "Associated Societies." These comprise such local bodies as exist for the encouragement of the study of science, but are not at present in a position to undertake and publish original investigations. The chairman, in opening the proceedings, dwelt on the useful work which these modest societies might accomplish, and suggested various ways in which local societies, whether belonging to the affiliated or to the associated class, might aid those sections of the British Association in which he was specially interested, namely, the sections of anthropology, economics, and educational science.

Dr. H. R. Mill delivered an address on local societies and meteorology, in which he commended the study of this science as peculiarly suitable for cultivation by the corresponding societies. Local climate can be determined only by a long, continuous record of local observations; and this continuity, so difficult to maintain by private observers, can be readily secured by a local society, which by its nature is, or should be, immortal. Sunshine and rainfall are two elements of climate which still need much further study. A vast body of meteorological observations in the past has been absolutely useless either because the instruments used were not trustworthy or the hours of observation were irregular; whilst in many cases the observations, otherwise of value, have lost their usefulness through not having been dealt with by competent authorities. In the course of a discussion, Mr. E. Kitto, the superintendent of the Falmouth Observatory, referred to the special value of the magnetic records regularly issued from his station. Dr. J. R. Ashworth, of Rochdale, pleaded for a meteorological survey of the British Islands—a work in which the local societies might obviously render material assistance.

The second meeting was presided over by Mr. J. Hopkinson, vice-chairman of the conference, who in his introductory remarks pointed out the great value of photographic surveys of counties. This subject was elaborately treated by Mr. W. Jerome Harrison, of Birmingham, in a communication on the desirability of promoting county photographic surveys. The paper gave a history of the movement, which was practically initiated by the author, and has spread from Warwickshire, where it was started, to several other counties, including Worcestershire, Essex, Surrey, and Kent. Mr. Harrison suggested that a committee should be formed to coordinate the photographic societies with the literary and scientific societies, so that all should join in the work of the surveys. The subject was warmly taken up by the delegates, and it was determined to apply, at next year's meeting, for the appointment of a county photo-survey committee. The Rev. Ashington Bullen suggested that at every meeting of the British Association there should be a photographic exhibition illustrating the archæology, ethnology, and natural history of the particular county in which the meeting was held. Prof. H. H. Turner referred to the value of pairs of photographs on the stereoscopic plan, inasmuch as they enabled the distances between various objects represented on them to be ascertained by calculation. In the course of the discussion much approval was expressed of the work of those committees of the British Association which dealt with photography as applied to geology, anthropology, and botany.

THE BOMBAY LOCUST.[1]

ANOTHER new venture among Indian memoirs has lately been issued, and if subsequent numbers are like this first instalment they will prove of great value. Mr. Maxwell-Lefroy deals in this first issue with the Bombay locust; we prefer to call it by its popular name, for its scientific one seems in doubt. Specimens were sent by Mr. Lefroy, and have been named at the British Museum by Mr. Kirby as *Acridium rubescens*, Walker, which is apparently quite correct; but we learn from this report that Mr. de Saussure assigns the Bombay locust to Linnæus's species *Acridium succinctum*. In this report the latter name is chosen as probably being most accurate, but it is extremely doubtful if Mr. Lefroy has made the right choice. It is best, therefore, as "doctors disagree," to call this pest simply the Bombay locust.

The work comprises 109 pages of letterpress and thirteen plates, the latter being an improvement on the majority we see from India. The report deals with investigations made in 1903–4, and contains an amount of useful information concerning "locust swarms."

Part i. is devoted to the subject of the formation and movements of locust swarms. In it the author shows and explains how a swarm arises, how from grasses in which they were concealed they entered the crops and "gradually formed into swarms and moved over the country-side." Then these definite bodies of locusts could be traced from village to village. Later they were shown to move in definite directions, migrating at nights, when their wings were constantly and suddenly seen glistening against the moon as they flew by, and as suddenly they vanished.

These swarms settled in the forest regions at last during November and December, and then in March and April a second or outward migration was traced. After the outward migration the swarms were shown to break up, and only scattered locusts could be found. A vast area of land thus became infested with them, but little or no damage was done, for "the locusts had apparently lost the swarming and migrating instinct." Reproduction then set in.

The summary given is as follows:—

Winged locusts emerged and entered crops	...	Oct. 1—20.
,, ,, migrated	...	Oct. 20—Nov. 30.
,, ,, remained in forests ...	...	Dec. 1.—March 20.
,, ,, migrated	...	March 20—May 20.
,, ,, scattered	...	May 20—June 10.
,, ,, reproduced and died ...	...	June 10—Aug. 10.

In part ii. Mr. Lefroy deals with the life-history of this locust, giving an account of the egg-laying, hatching, development, and the description of the "hoppers" after each moult.

In part iii. are related the habits of locusts and methods employed for their destruction. The first is dealt with in a clear and interesting manner, and is well worth the study of anyone engaged in locust work.

The rewards given for collecting this pest and its eggs varied, but during cold weather winged locusts were paid for at the rate of ¼ to ½ anna per seer (2 lb.), and this pay was sufficient to give a fair wage to an active man. Later 4 annas were paid per seer, a seer containing 400 to 450 locusts. Amongst natural enemies mentioned we notice monkeys, the striped squirrel and the grey-necked crow, and several insects. No doubt these all do some good, but to rely on them to prevent locust swarms is futile. Amongst methods of destroying these noxious insects is the employment of poisoned baits. Experiments recorded here show that a weak solution of arsenate of lead proved better than a strong solution of sodium arsenate or the well-known Natal locust mixture. More than 80 per cent. of the locusts were killed when fodder baits were sprayed with 1 lb. of lead arsenate, and 5 lb. of jaggery, to 100 gallons of water, in twelve hours. For

[1] "Memoirs of the Department of Agriculture in India." Vol. i., No. 1. By H. Maxwell-Lefroy. (Calcutta, April, 1906.) Price Rs. 2.8.