shale and a thin seam of coal, neither being of any value. The remainder of the Cenomanian, above the Nubian Sandstone, contains many fossils, and includes some beds of oil-bearing marls, not, however, valuable. The limestones above these represent the Turonian and Santonian, but are not nearly so rich in fossils as the underlying beds. Eocene strata succeed, chiefly clays, and to them sandy clays and grits representing the Miocene, both being fossiliferous; the coastal deposits are Pleistocene and Recent. The rather frequent dykes and sheets of basalt are probably Miocene, to a later part of which belong the numerous faults. In the neighbourhood of these the strata are often much tilted, but otherwise are not far from horizontal. In one district occur associated ores of iron and manganese, which are now being worked.

The climate is temperate, dry, and very healthy.

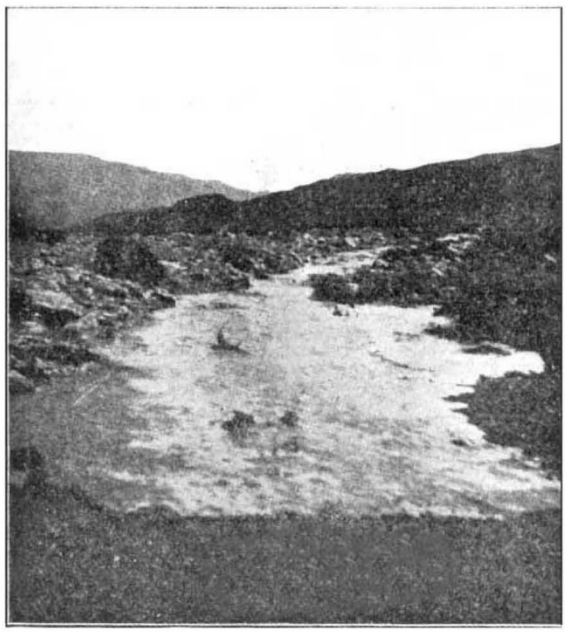

FIG. 1.—View of the "Seil" in Wadi Abu Qâda, February 14, 1913. From "The Geography and Geology of West-Central Sinai."

In winter the frequent north winds cause sharp frosts in the higher districts, but on the coastal lowlands it is often warm and misty. The rainfall is very slight, generally not more than an inch in a year. But a heavy rainstorm may occur every four or five years, when the water, running rapidly off the steeply sloping sides of the valley, gives rise to a sudden flood which sweeps everything before it. Dr. Ball was fortunate enough to secure a photograph showing the front of one of these torrents, of which Fig. 1 is a reproduction. One such flood in 1867 swept away an Arab encampment in Wady Soláf, drowning forty persons, with many camels, sheep, and cattle. But at other times the only sculpturing agents are wind-blown sand and strains set up in rock surfaces by changes of temperature, both, as Dr. Ball describes, of considerable importance. But it is scarcely possible that the deeply carved valleys can be the result of existing conditions; probably they were produced when the rainfall was much greater, its later part corresponding with an age of ice in our own islands, when a great lake occupied the Jordan valley.

There is, as a rule, little vegetation or animal life. Of what is found Dr. Ball gives particulars. In short, we are indebted to him for a very full and clearly written account of the geology, geography, and natural history of this part of the Sinai Peninsula, the value of which is enhanced by many illustrations—photographs of scenery, drawings of fossils, and a coloured geological map. Both he and the Survey may well be congratulated, especially in existing circumstances, on the publication of so excellent a memoir.

T. G. BONNEY.

THE PHYSIOLOGY OF FATIGUE.

ONE effect of the war has been to increase the strain thrown upon industrial workers as a result of longer working hours and insufficient holidays, and efforts are being made not only to counteract the ill-effects of extreme physical fatigue, but also to devise means for the recognition of fatigue and to study the conditions under which it occurs. The latter aspect of the question is dealt with by Prof. Kent in a report on industrial fatigue recently issued by the Home Office.[1] For this purpose Prof. Kent employed as tests of the occurrence of fatigue, in the first place, alterations in the length of the reaction time and in the visual and auditory acuity of the worker, and, in the second place, the influence of overtime upon the actual output of the worker. A number of workers were examined, the observations in some cases extending over several weeks.

The general conclusion drawn from the inquiry is that overtime—that is to say, a longer working day—leads to increased fatigue, this being manifested both by the physiological tests employed and by its effect upon the efficiency and output of the worker. The evidence furnished by the physiological tests is, however, quite unconvincing; not only do the figures obtained by these tests vary enormously from day to day, but in some instances the tests indicate that the workers are less fatigued in the evening than in the morning, and less tired after a long working day than after a short day. Further, the purely subjective character of these tests renders them liable to be influenced by many causes other than fatigue, and they appear to have little or no value as an index of general fatigue.

The observations on the effect of overtime upon the daily output of work are of interest because, in some instances, the output of the same workers was noted during weeks when overtime was worked and during weeks when no overtime was worked; the total output was unaffected

[1] Second Interim Report on an Investigation of Industrial Fatigue. By Prof. A. F. Stanley Kent. [Cd. 8335.] (Issued by the Home Office.) price 1s. 6d.

or even lessened by lengthening the working day. The author does not take into consideration, however, the view, now becoming recognised, that a worker with a long day before him tends, consciously or unconsciously, to conserve his energy and to distribute it uniformly throughout the day. It is not improbable, indeed, that the ill-effects of unduly long working hours may be not so much the direct result of a greater expenditure of energy as the indirect result of shortening of the time available for leisure and recreation.

NOTES.

LONG lists of New Year honours—mostly conferred for services rendered in connection with military or naval operations—were published on Monday. We notice in these lists the following names and distinctions:—*K.C.S.I.*: Sir Francis E. Younghusband, the distinguished traveller and geographer; Maj.-Gen. R. C. O. Stuart, Director-General of Ordnance in India. *C.I.E.*: S. M. Burrows, secretary to the Oxford Delegacy for Oriental Students; P. J. Hartog, lately secretary to departmental committees on the organisation of Oriental Studies in London. *Kaisar-i-Hind Medal for Public Services in India, First Class*: Sir F. A. Nicholson, Honorary Director of Fisheries, Madras; and Dr. H. H. Mann, principal, Agricultural College, Poona, and agricultural chemist, Bombay. The following medical men are among those on whom honours are conferred for services in the field:—*K.C.B.*: Surgeon-General H. R. Whitehead. *C.B.*: Col. J. M. Irwin, Col. R. L. R. Macleod, Col. G. Cree, Col. A. A. Sutton, Col. G. H. Barefoot, Temp.-Col. T. Sinclair, Lieut.-Col. E. T. F. Birrell. *K.C.M.G.*: Col. M. P. C. Holt. *C.M.G.*: Col. T. Daly, Col. W. L. Gray, Col. F. R. Newland, Col. H. T. Knaggs, Col. H. I. Pocock, Col. B. H. Scott, Col. R. W. Wright, Col. T. Du Bedal Whaite, Col. F. J. Morgan, Temp.-Col. T. C. English, Lieut.-Col. A. R. Aldridge, Lieut.-Col. J. D. Ferguson, Lieut.-Col. F. H. Withers, Lieut.-Col. F. R. Buswell, Lieut.-Col. L. F. Smith, Lieut.-Col. F. A. Symons, Temp.-Lieut.-Col. G. M. Holmes, Temp.-Lieut.-Col. H. L. Eason.

WHEN the Germans introduced the use of poisonous gases into warfare, immediate steps were taken by our military authorities to provide the troops with means of protection from them, and action was taken later to organise offensive as well as defensive measures. The matter was put into the hands of leading chemists, physicists, and physiologists, with the result that our gas attacks are now more effective than those of our enemies. Field-Marshal Sir Douglas Haig, Commanding-in-Chief the British Forces in France, makes the following reference to this subject in his despatch dated December 23, 1916:—"The employment by the enemy of gas and of liquid flame as weapons of offence compelled us not only to discover ways to protect our troops from their effects, but also to devise means to make use of the same instruments of destruction. Great fertility of invention has been shown, and very great credit is due to the special *personnel* employed for the rapidity and success with which these new arms have been developed and perfected, and for the very great devotion to duty they have displayed in a difficult and dangerous service. The Army owes its thanks to the chemists, physiologists, and physicists of the highest rank who devoted their energies to enabling us to surpass the enemy in the use of a means of warfare which took the civilised world by surprise. Our own experience of the numerous experiments and trials necessary before gas and flame could be used, of the great preparations which had to be made for their manufacture, and of the special training required for the *personnel* employed, shows that the employment of such methods by the Germans was not the result of a desperate decision, but had been prepared for deliberately. Since we have been compelled, in self-defence, to use similar methods, it is satisfactory to be able to record, on the evidence of prisoners, of documents captured, and of our own observation, that the enemy has suffered heavy casualties from our gas attacks, while the means of protection adopted by us have proved thoroughly effective."

THE Canadian Government has appointed an honorary advisory council on scientific and industrial research to advise a committee of the Cabinet on all matters relating to scientific and industrial research, with the view of securing the united efforts of scientific workers and industrial concerns, and of selecting the most pressing problems indicated by industrial necessities to be submitted to research institutions and individuals for solution. We learn from *Science* that the members of this advisory council are:—Dr. A. S. Mackenzie, president of Dalhousie University, Halifax, N.S.; Dr. F. D. Adams, dean of the faculty of applied science, McGill University; Dr. R. F. Ruttan, professor of chemistry, McGill University; Dr. J. C. McLennan, director of the Physical Laboratories, University of Toronto; Dr. A. B. Macallum, president of the Royal Society of Canada, University of Toronto; Dr. W. Murray, president of the University of Saskatchewan, Saskatoon; Mr. R. Hobson, president of the Steel Company of Canada, Hamilton, Ont.; Mr. R. G. Ross, consulting electrical engineer, Montreal; and M. Tancrède Bienvenu, manager of La Banque Provinciale, Montreal. The question of co-operation between the scientific men of the country and industrial concerns with the view of solving the problems raised by the war and of placing the industrial resources of the country in a position to meet the conditions that will arise after the war has been under consideration by the Government and by representatives of science and industry for some time, as it was felt to be desirable to follow the example of the British Government in this matter. In a memorandum Sir George E. Foster, Minister of Trade and Commerce, has pointed out "the urgent need of organising, mobilising, and economising the existing resources of scientific and industrial research in Canada with the purpose of utilising waste products, discovering new processes—mechanical, chemical, and metallurgical—and developing into useful adjuncts to industry and commerce the unused natural resources of Canada."

METEOROLOGY has lost one of its most ardent supporters by the sudden death of Mr. William Marriott at Dulwich on December 28. He was sixty-eight years of age, and throughout his life had been remarkably free from illness, but latterly heart trouble had developed. Mr. Marriott commenced his meteorological work at Greenwich Observatory in January, 1869, and he left the observatory at the end of 1871. Whilst at the Royal Observatory he was in the magnetic and meteorological department under Mr. James Glaisher, F.R.S., who was very actively associated with the Meteorological Society. Mr. Marriott became assistant-secretary to the Meteorological Society in 1872, and he maintained the position until his retirement in September, 1915, after forty-three years' service. He had become a member of the society whilst serving at Greenwich, in 1870. The science of meteorology has steadily developed during the last half-century, and Mr. Marriott, in his official capacity, took the keenest