nature of an unsaturated fatty acid, since Meyerhof has shown that the oxidation of linolenic acid is accelerated by the simultaneous oxidation of a sulphydryl group present at the same time. Thus the oxidation of the fatty acid depends on the presence of the reduced glutathione, which in turn is formed by the "hydrogen donators" of the tissues. When oxygen acts as a "hydrogen-acceptor," removing the hydrogen from the reduced glutathione which is thereby oxidised, part of the oxygen becomes activated and available for the oxidation of other substances present in the cell.

The Royal Observatory, Edinburgh, and Accurate Measurements of Time.

THE record of the work done in 1924 at the Royal Observatory, Edinburgh, recorded in the annual report of the Astronomer Royal for Scotland, Prof. R. A. Sampson, is of supreme importance to those interested in the accurate measurement of time.

For some years Edinburgh has taken the lead in this subject, and Prof. Sampson's papers before the Royal Society of Edinburgh and the Royal Astronomical Society on the performance of his clocks have been followed with keen interest in the observatories of the world. His three first-grade clocks are the Riefler No. 258, which, we understand, is one of the best turned out by the famous Munich firm; Leroy No. 1230, which is a duplicate of those at the Paris Observatory used in connexion with the time transmission from the Eiffel Tower; and Shortt No. 0, the original Free Pendulum of the Synchronome Co.

By means of an oscillograph and micro-chronograph, which resembles a cinematograph camera, Prof. Sampson's clocks are in effect *put under a microscope*, that is to say, their performance is observed and automatically recorded each day to an accuracy of one thousandth part of a second, a method which Prof. Sampson says "rarely fails to show when one or other of them has changed rate by as much as ·01 sec." The daily comparison, he continues, demonstrated a decided superiority in the rate of clock Shortt; indeed the other two were scarcely able to serve as a check upon it. Therefore, with the view of carrying time work to the limit that the appliances will allow, a second model of the clock (Shortt No. 4) was installed in January in one of the vacant clock cells in the basement. The connexions for temperature control are the same as in the other cells. The original clock of these series (Shortt No. 0) which was erected here for trial by Mr. Shortt in 1923, and has shown such remarkable going, has been generously presented to the Observatory by the Synchronome Company Limited, in association with whom Mr. Shortt had prepared his model. Briefly, it may be said the only discernible faults in the going of Shortt No. 0 are a small temperature coefficient showing when an accident disturbs the temperature control of the cell, and a minute leak in the case, which has not been located.

Prof. Sampson's investigations in recent years have focussed attention upon the lack of precision in transit observations, upon which, of course, all time determinations are based. Instrumental errors in the transit circle telescope have always been carefully measured and allowed for. They take a prominent part in the somewhat complex process of smoothing the clock rates. In the race for accuracy, the precision of the clock and of the means of comparison by wireless time signals have outrun the precision of transit observations.

Radio telegraphy has enabled distant observatories to compare their times with great precision, thanks to the rhythmic signals or "time-vernier," and they are found to disagree by amounts which, though they may appear trivial to a layman, are of considerable importance in an exact science such as astronomy. Astronomers have indeed been considerably perturbed at their lack of agreement, and Prof. Sampson had set himself the task of searching for the cause of the error which has been found to occur in time determinations at all observatories.

Prof. Sampson now makes the definite statement that "owing to improvements in the clock and chronograph system in this Observatory, and in receiving apparatus for W.T. signals from other observatories, it has proved possible to bring this investigation to an issue. It has been found that during the whole of 1924 the whole of the large erratic or systematic errors are removed if the level error, determined as usual by the mercury bath, is rejected, and the observations reduced instead by an azimuth error derived from one of the collimators, in combination with the usual observations of polar stars. The implications of this result are of high interest and importance to astronomers and will be pursued."

Referring later to his automatic records of the numerous W.T. signals, Prof. Sampson says, "the comparison of time determined at this observatory with the same determined elsewhere exhibits features of the sub-systematic character that had been noted in previous years, though each observatory had cleared its determinations of all known errors. As remarked above, the source of these discrepancies appears now to be located, at least so far as the observatory is concerned."

F. H.-J.

World Meteorology and Long-range Forecasting.[1]

THE possibility of seasonal forecasts in India was first investigated by H. F. Blanford about 1876, using only the snowfall in the Himalayas. As the research proceeded, it was found necessary to consider conditions farther and farther away, until in the hands of Sir Gilbert Walker it developed into an investigation of the inter-relationships of weather in all parts of the world. A chart of the average barometric pressure over the globe shows a number of more or less permanent areas of high and low pressure; for example, the Azores high and the Icelandic low. In these areas the variability of pressure reaches a maximum, and they are accordingly termed "centres of action"; the pressure changes of intervening places, such as the British Isles, are dominated by those at the centres of action.

Sir Gilbert Walker has realised that these "strategic points" offered the best chances for an attack on the problem of long-range weather forecasting, and has studied in great detail the relations between twenty different centres of action. In "Correlation in Seasonal Variations of Weather," Part 8 (Memoirs of the Indian Meteorological Department), published in 1923, he laid down the groundwork of a theory of world weather and outlined the mechanism by which variations in one part of the world are transmitted to other parts of the world a few months later. The

[1] "A Further Study of World-Weather. Applications to Seasonal Forecasting in India." By Sir G. T. Walker. (Memoirs of the Indian Meteorological Department, vol. 24, Parts 9 and 10.)

problem is, however, too complex for a sufficiently complete theoretical solution to be possible at present, and the only method is the patient comparison of the pressure variations in each centre of action with the subsequent variations in all twenty centres. This laborious research has been carried out, and the results are presented in Part 9, "A Further Study of World Weather." The quarterly means are compared with those for two quarters before, one quarter before, the same quarter and one and two quarters after, at all stations—some 4000 correlation coefficients in all. From these coefficients 189 relationships are found which are probably significant according to the author's rigid standard, and are of value for seasonal forecasts either six months or three months ahead.

The consistency of the relationships is very remarkable, and "supports the view that seasonal forecasting is capable of wider application than at present." Most of the significant relationships discovered are between the different tropical and sub-tropical centres, at which weather abnormalities usually persist for several months, and the research indicates possibilities for the initiation or improvement of seasonal forecasting in such regions. For countries within the temperate storm belts, such as the British Isles, the outlook is not so hopeful; the significant correlation coefficients are fewer and smaller, and the fluctuations from month to month are often so great that the value of a general three-monthly forecast is limited. The final solution of the problem of long-range forecasting in temperate latitudes will undoubtedly have to take account of world-relationships, but only as giving a general tendency to the weather, the fluctuations of shorter period being determined by other and more local causes.

In Part 10 Sir Gilbert Walker returns to the original purpose of these studies and gives an example of the application of the results to seasonal forecasting in India. From the closest relationships found between rainfall in India and the preceding conditions in other parts of the world, greatly improved formulæ are deduced for forecasting the monsoon rainfall of different districts and the winter precipitation of the Himalayan region. The formulæ impress one very strongly with the meteorological unity of the world, that for Peninsula rain, for example, depending on the preceding conditions in such widely scattered regions as Alaska, South America, and Rhodesia. The statistical basis is sufficiently complete for the forecasts to be made confidently; and while in the story of Indian forecasting, begun fifty years ago, the final chapter is not yet written, we may reasonably believe that the main lines of the plot have been laid bare.

University and Educational Intelligence.

IN the course of an address delivered on September 4 at the opening of a new secondary school at Preston Lodge, East Lothian, Lord Balfour made some noteworthy remarks on the relation of schools to universities and on the importance of research in pure science. If the university is compelled to act the part either of the primary or secondary school its work is hampered, its utility diminished, and its wheels clogged. The purpose of the secondary school is, however, not merely to prepare students for the university, but rather to give an education by means of which those who are unable to go to the university can face life without feeling seriously handicapped. Referring to the importance of the practical teaching of science, Lord Balfour said he was glad to learn that science is to form a prominent part of the curriculum of the new school, and that it is to be taught by laboratory demonstration and experiments. "Industry in the future," he said, "must be based upon science." If industrialists imagine that science can be built up without a disinterested love of knowledge, they fall "into the most grievous blunder." The multiplication of subjects in modern secondary and university education and the specialisation it entails are regarded by some as disastrous to the progress of education and the highest interests of culture and learning. Lord Balfour stated that, if the dangers of specialisation are kept in view, they can be reduced to a minimum, and the necessary flexibility, variety, and complexity of modern education successfully maintained.

THE Geographical Association has been experimenting for some time in the matter of conducted educational tours for teachers under the direction of volunteer experts. Some teachers and members of several universities joined a group of honours students in geography, of the University College of Wales, Aberystwyth, at Easter, in a tour around France, under the direction of Miss S. Harris, of the staff of that College. At the beginning of August, two groups left England to study the Alps; one the western Alps, starting from Chamonix, and one the eastern Alps, starting from Innsbruck. They were under the leadership, respectively, of Mr. J. I. Platt and Miss S. Harris, both of the University College of Wales, Aberystwyth. Among their objects was the demonstration of the newer views of earth history, and especially of mountain building, to which MM. Argand and Staub have given expression in the last few years. The charabanc has made it possible for teachers to intensify their knowledge of Britain, and tours have been organised to various natural regions of England, and to North and Central Wales, to demonstrate structural and general physical features with particular reference to the ways in which these factors have affected settlement, industries and communications. These tours were organised under the leadership of Messrs. E. E. Lupton and V. C. Spary. The Tours Committee of the Geographical Association would like to experiment further by specialising on selected regions for more intensive study if a sufficient number of members and intending members care to take part. All communications concerning tours should be sent to the honorary secretary of the Tours Committee, Mr. E. E. Lupton, 73 Bierley Lane, Bradford.

THE Institute of Intellectual Co-operation, of which the governing body is the League of Nations Committee on Intellectual Co-operation, presided over by a French member of the Committee, is expected to open its doors towards the end of the year. The directorate of the Institute is composed of the following members: M. Bergson, M. de Reynold, Prof. Lorentz, Prof. Gilbert Murray, and Senator Ruffini. The Director is M. Julien Luchaire, Inspector-General of Education in France. The budget for 1926 amounts to 2,100,000 French francs, two millions of which represent the grant made by the French Government and 100,000 that of the Polish Government. The Committee at its meeting of July 27-30 approved of the adoption of an international students' card as recommended by the International Students' Federation. It took note of a memo by Dr. Hagberg Wright, Director of the London Library, on the subject of the international borrowing of books, and recommended a series of practical measures for facilitating such loans. It considered also questions relating to intellectual property, an international meteorological bureau, an international university for the training of statesmen, journalists and others, the unification of scientific nomenclature, and a loan for the development of intellectual life.