only precursor. However, there were many negative results. It may be that positive results are only obtained when the administration of fat coincides with a temporary increase in the capacity of the liver for glyconeogenesis. It was also noticeable that it was impossible to recover animals with insulin when the experiment had been successful.

Whatever the defect in carbohydrate metabolism in diabetes, it does not apparently concern the actual utilisation of carbohydrate in muscle, in spite of the fact that the rate of withdrawal of sugar from the blood by the tissues is less than usual: thus I. L. Chaikoff and J. J. R. Macleod (*Quart. J. Exp. Physiol.*, vol. 19, p. 291; 1929) found that the response of normal and diabetic dogs to shivering was the same so far as the increased respiratory metabolism and rise in the respiratory quotient were concerned: the protein metabolism was not increased. The quotient fell after ½ hour or so, apparently indicating the formation of carbohydrate from fat.

These short summaries indicate the trend of some of the recent work on insulin and must be taken as covering only a small part of the field: they indicate routes, however, by which the problem of the mechanism of the action of insulin is being approached.

Faraday's Diary.

By THOMAS MARTIN, General Secretary of the Royal Institution.

IT has now been announced that, to mark the forthcoming centenary of the discovery of electromagnetic induction, the Managers of the Royal Institution have resolved to publish a document of exceptional scientific interest and importance, Faraday's "Diary". It may therefore be opportune to give some particulars of the manuscript and of how it came to be written. Scientific men have been aware of its existence for upwards of sixty years, and Bence Jones, Silvanus Thompson, and other writers on the life of Faraday have consulted it for material and have quoted passages from it in their writings; but few of the present generation, to whom the name of Faraday has become a household word, can be fully aware of the nature and extent, the scientific and biographical significance, and the extraordinary interest of these hitherto unpublished papers.

The Managers' Minutes of Nov. 4, 1867, record the bequest by Prof. Faraday to the Royal Institution of six folio volumes of "Experimental Notes", two quarto volumes of similar notes, and some unbound MSS. The actual wording of the bequest (1855) is as follows: "Various philosophical notes of experimental investigation on foolscap paper, paged in series, and partly bound in five volumes, a quarto book of Philosophical Notes, a second larger quarto of similar notes. . . ." At the time of Faraday's death the number of bound volumes had evidently increased to six, and after his death the loose papers were bound up, by order of the Managers, in the same style of binding as that previously used, making folio volumes 7 and 8. These eight folio volumes, together with the two quartos, make up the "Diary" as it exists to-day.

The manuscript extends to more than four thousand pages, covering a period of forty-two years, from 1820 to 1862; and provides, indeed, an almost complete and uninterrupted record of the whole of its author's original experimental work. It is written throughout in his own fine, clear hand, with only occasional lapses into illegibility, and with a very few inclusions of matter written by others, but which is nevertheless related to his work.

A very noticeable characteristic, on turning the pages, is the extremely orderly and methodical way in which the notes were kept, very different from the untidiness of the experimental notes of his predecessor at the Royal Institution, Humphry Davy. Every page of Faraday's "Diary" is dated and every paragraph is numbered. No paper is wasted, every sheet being completely filled with writing, and a very large number of the paragraphs are illustrated, always towards the right-hand margin of the sheet, by freehand sketches in ink. These sketches are roughly drawn, with boldness and economy of line, but many of them are very striking, and give an impression of the apparatus they represent which is entirely adequate for the purpose and far more pleasing than that of the more formal diagrams which accompany the published papers.

In the earlier parts of the "Diary" the numbering of the paragraphs is begun afresh in several places, but from the beginning of folio volume 2 an unbroken sequence is preserved almost to the end, the numbered paragraphs in this series running to over 16,000. The numbers are constantly used for reference to earlier observations. It will be recalled that a similar sequence of numbers runs through the published "Experimental Researches in Electricity", although it should be mentioned that there is no correspondence between the numbers in the "Diary" and those of paragraphs in the published works which describe the same observations. Many, perhaps most, of the pages and separate paragraphs have a pencil line drawn through them, vertically down the middle of the page; and it seems to have been Faraday's practice to cross through in this way matter transferred to or made use of in the preparation of his published papers.

The manuscript is not a diary in the commonly accepted sense. It is not a journal or daily record of events, but a laboratory note-book. It was evidently its author's custom to keep it written up from day to day, as his experiments proceeded.

Its contents are entirely scientific, and although it contains observations made outside the laboratory, these are generally such as have a bearing on his work, as when, for example, during the progress of some experiments on the crispations or undulations caused by vibration on the surface of a liquid, he saw one wet day a brewer's dray rumbling over the cobbles, and noticed that the rainwater collected in the tops of the empty butts was thrown up into heaps very like his crispations.

Most of the work was carried out in his laboratory at the Royal Institution, but from time to time observations elsewhere are described, as when in 1831, in the course of the experiments on induced electric currents, he worked "at Mr. Christie's" with the Gowin-Knight magnet of the Royal Society; and later, when he obtained leave of the King and stretched a wire across the Round Pond in Kensington Gardens, with plates in the water, to test some ideas on the possibility of induction by the earth's magnetic field, hoping to observe effects due to the diurnal rotation of the earth.

The entries in the "Diary" describe, with every detail of importance or which may conceivably have any bearing on the result, the apparatus he used and the modifications he made in it from time to time as the experiments proceeded. The effects he expected to find and the observations he actually made were set down with the utmost care and precision, and when the results were not in accordance with his anticipations or appeared to be due to defects in the arrangement of the apparatus, they were nevertheless recorded with the same care as when his best expectations were realised. His extraordinary skill and ingenuity as an experimenter and his perseverance in the face of disappointment are constantly brought home to the reader, who may see how he followed, day after day, the same line of thought and tried first this and then that modification until he was satisfied that the effect he was looking for was or was not there and had exhausted every possibility.

Although the "Diary" is a laboratory book containing particulars and sketches of apparatus and numerical and other data to be transcribed, an aid to memory to be drawn upon in the subsequent preparation of his papers, it is more, much more, than a dry record of facts. From its form and from the care with which it was preserved it is evident that he intended it as a personal record of his work to be kept and referred to. The pages are interspersed with little characteristic passages which serve as windows into the mind of the man, and give to the manuscript a personal character and spontaneity which is absent from his formal papers. His enthusiasm for discovery is evident if only from the extent and variety of the work which is recorded and the persistence with which he works at a problem until experiment has given the answer to his speculations. The originality, the fertility and resourcefulness of his scientific imagination are shown at every turn, in the nature of the problems he sets himself to resolve, the apparatus he devises to test his theories, the points he notes down as worthy of further investigation. Frequently the pages describing a particular research will end in two or three paragraphs in which he poses new problems, fresh ideas for research which have been suggested by the work that has gone before.

The pages are full of titbits of laboratory information which throw light on the apparatus and methods of a hundred years ago and will delight the heart of the chemist or physicist of to-day. He insulated the wire of the coils he used in his famous experiments on induced electric currents by interposing twine between the turns of bare wire and separating the layers by strips of calico. Many of his galvanometers he made himself, in the roughest and simplest way. He used the tall glass jar from a "guinea and feather fall" in which to construct a delicate instrument for detecting induced currents. "White of egg", he notes down, "is a very good thing for crispations." He constantly remarks on the wonder and beauty of the effects he obtains. He cannot keep the note of elation from his voice as he underlines and doubly underlines the significant observation in some particularly satisfactory trial, and concludes the description with the words "Very good experiment".

The "Diary" shows, as no other document could do, the gradual unfolding in Faraday's mind of the ideas which led him to his great discoveries. In his series of communications to the Royal Society the matter of his notes was rearranged and expanded, the phrasing made more formal, the descriptions amplified, and the conclusions stated. Reference to many of the unsuccessful attempts was omitted. In the "Diary" the experiments are recorded in the order in which they were actually made. Step by step his progress can be traced. The entries are often brief and without regard for grammar, but it is not difficult to supply the deficiencies and to read between the lines. His thoughts, the movement of his ideas towards the conclusions which he reached and published, may be inferred from the nature of his experiments and the order in which he made them. Probably no other man of science of comparable eminence has left a personal record which is at once so complete and so enlightening, so invaluable a key to the development of a great scientific mind.

The first volume of the manuscript is the smaller of the two quartos, a small green-covered notebook. This was used from September 1820 to December 1823. Faraday's scientific work in these early years (he was twenty-nine years of age in September 1820) was largely chemical and analytical, including the investigation of new compounds of chlorine and carbon, but the volume contains also a few important electrical experiments. The entries for September 1821, for example, record his well-known first experiments on electromagnetic rotations, which led to the misunderstanding with Dr. Wollaston. That for Christmas Day 1821 describes how he first succeeded

in making a wire carrying an electric current rotate under the influence of the earth's magnetic field alone. The second, larger, quarto volume covers the period December 1823 to November 1832. Its contents are also largely chemical, and it contains the record, in May 1825, of the discovery and analysis of bicarburet of hydrogen (benzene).

The second quarto is no more than two thirds filled. Evidently in 1831 Faraday decided to keep his notes on loose sheets of foolscap paper, and from that date onwards (there is some overlapping between the second quarto and the first folio) the "Diary" is on sheets of this character which have been afterwards bound up into volumes. The slim folio volume 1 (February 1831 to June 1832) must be one of the most significant, as it is certainly one of the most interesting scientific manuscripts in existence, for besides some experiments of a miscellaneous character, it contains substantially the record of the work communicated to the Royal Society in the first and second series of the experimental researches in electricity, embodying the discovery of electromagnetic induction. The induction of an electric current in a coil of wire was first successfully obtained, by 'make' and 'break' of the current in an adjacent voltaic circuit, in the famous ring experiment on Aug. 29, 1831.

It is impossible, within the limits of a short article, to give even a summary of the contents of the "Diary". Moreover, one at least of the published volumes will be available, it is hoped, in time for the Faraday Celebrations in September 1931. The notes are carried on from 1831, through the eight folio volumes down to the year 1862, when his powers were failing and his experimental work was at an end. An entry for Mar. 12, 1862, records an experiment which seems to be the last he ever made. He was hoping to obtain an effect of magnetism on light. He failed to find it. It was not the first time he had made this experiment unsuccessfully; but his scientific intuition was not at fault, for others have since found the effect that he was seeking.

Obituary.

Prof. Adolf Engler.

THE death of Heinrich Gustav Adolf Engler, aptly described as the *Altmeister* of systematic botanists, on Oct. 10, in his eighty-seventh year, removes a prominent and striking personality from the botanical world. 'Engler's System' is a phrase familiar to all students of the science, and has been in recent years a subject of warm discussion among those interested in phylogeny and more especially in the 'natural' arrangement of the families of flowering plants. In his student days, Engler came under the influence of the great German systematist Eichler, whose 'System' was a definite attempt to arrange plant-families in series advancing from the more primitive to the more highly specialised; the simplest type of flower was regarded as the earliest and advance implied an increase in number of parts and specialisation of structure. Engler's 'Syllabus', which was a modification of Eichler's system, has been widely used in systematic works and a large proportion of Continental and American 'floras' follows his arrangement. The criterion of primitiveness has been challenged by the school which regards the simplest types of flowers to be reduced and not primitive forms, but in the recently published edition of his 'Syllabus' the veteran botanist vigorously defends his position and suggests that the less-known parts of the African continent may conceal forms which will provide links in support of his theory.

The 'Syllabus' was the basis of arrangement of "Die natürlichen Pflanzenfamilien", a systematic description of the families and genera of plants, initiated by Prof. Prantl and Prof. Engler in 1887 and carried to completion by Engler after Prantl's death early in the progress of the work. The "Pflanzenfamilien" had a wider appeal among botanists than the more erudite and more strictly technical "Genera Plantarum" of Bentham and Hooker. The distribution of the work of compilation among a large number of botanists led to a certain inequality of treatment; but it went far beyond any previous production as a revision of the families and genera of all the groups of the vegetable kingdom. A new and enlarged edition is in course of publication, and of two large volumes issued during the present year under his editorship, Engler was also the author of the greater portion of one and of part of the other, a tribute to his remarkable virility and continued power of work.

A still more ambitious production was the "Pflanzenreich", begun, with Engler as editor, in 1900: a series of complete monographs of the families of flowering plants; a large number of volumes have already appeared.

Engler was in the prime of life when in 1889 he went from the University and Garden of Breslau to Berlin, as professor in the University and Director of the Botanic Garden and Museum. His first scientific post was under Prof. Nägeli in Munich, and his earlier work dates from that University and Botanical Museum and Garden.

One of his early interests was the Saxifrages, on which he published a monograph in 1872. He also contributed (1878–82) monographs of several families to Martius's monumental "Flora Brasiliensis"—which was continuing under Eichler's editorship. Among these was the Aroids, a family Engler made specially his own, and monographed in de Candolle's "Monographia Phanerogamarum", where he elaborated an arrangement of the genera on genetical lines. A developmental study of world floras found expression in his "Versuch einer Entwicklungsgeschichte der Pflanzenwelt seit der Tertiärperiode" (1879–82); and the series of volumes entitled "Die Vegetation der Erde" organised by the late Prof. Oscar Drude and himself in 1895 continues to provide authoritative accounts by experts of the