and a new balance for determining ginning percentage, fibre quality in relation to mixtures, twist and yarn strength, neps and fibre quality, prediction of spinning quality from fibre particulars, cellulose sheets from linters, etc., are given. An important advancement reported is the micro-spinning technique — standard spinning process for a 60 gm. sample (as in Giza Station) and the fineness measurement by air permeability (similar to Hertel's method) which should be of considerable utility to the Industry. A summary of the paper on maturity coefficient for Indian Cottons—an improvement over Peirce and Lord's formula, is given.

The list of publications from the Laboratory as also the additional equipment purchased with details of staff, etc., are included. While it is an impressive record of the vast amount of valuable routine and research work accomplished by the Laboratory the reviewer feels that it is necessary to expand considerably its sphere of activities, so that research on industrial problems, problems of immediate and remote application in spinning, weaving, finishing, etc., are tackled by the Laboratory on the lines of the Shirley Institute instead of tabooing weaving and finishing as at present. Concentration on original research, either fundamental or applied, would perhaps in the long run be of greater benefit to the country.

If the textile industry of independent India should stand world competition, research on every aspect, from the growing of the raw material to the manufacture of the finished product and its marketing, is essential. While the Laboratory deals principally with fibres and yarn it does only a part of a job which can never be as good as doing a whole job.

The book is practically free from misprints and conforms to the usual standards of elegance of the Committee's publications; '30s' should be short for '30 counts' and as such whether '30s counts' (page 51) is correct, requires clarification.

SRINAGABHUHANA.

AQUAMETRY *

THE importance of estimation of water cannot be over emphasised both in the laboratory and in industry. The influence of moisture on chemical kinetics has been a vast subject of intensive investigation and a quick and accurate method of determination of moisture in this field of research is of paramount importance. The determination of moisture in edible and in industrial products is in no way less important. The keeping quality and the behaviour towards milling of a large number of cereals are found to be dependent on their moisture content. The breakage of the grain would enormously increase on milling if the paddy were to contain more than 13% water. The moisture content of rice should always be less than 12% for its preservation. The water content of coffee, wheat and potato chips should always be less than 12%, 9% and 7% respectively in order to ensure freedom from attack by insects and pests. Moisture plays an important role in the preservation of fruits, egg and milk powders, beverages, confectionaries, starch, oils, fats and a host of other edible products. Narrow limits of moisture content are prescribed for a large number of explosives, fuel and transformer oils, drugs and fertilizers to ensure the purity of the product and safety of preservation. The importance of a knowledge of water content in the evaluation of textiles can be visualised when it is seen that cotton and wool can take up moisture up to 25-30%. The instances mentioned above are but a few of a host of other commodities where quick and accurate method of determination of moisture is of utmost importance.

Oven drying is the oldest and perhaps the most widely employed method for the determination of moisture. Even today it is the simplest method for drying non-porous solids having no other volatile material Recently several automatic moisture recorders have been put on the market where the humidity, gas circulation and the temperature of drying can be controlled with precision. The introduction of infrared radiation as a source of heating is the latest innovation in oven drying. With this improvement, the material to be dried is uniformly heated and the temperature of dehydration is lowered. In spite of these improvements the oven method is never satisfactory either for porous solids or for substances that undergo decomposition at the temperature of heating. It is needless to say that this method cannot be employed in the case of volatile liquids.

The distillation method is usually employed in industry where a large number of samples

**Aquametry.* Application of the Karl Fischer Reagent to Quantitative Analysis involving Water. By John Mitchell (Jr.) and Donald Milton Smith, Interscience Publishers Inc. New York, 1948. Pp xi+444. Price $ 8·00.

are to be analysed for their water content. The principle in general consists in distilling the material with an organic liquid immiscible with water and measuring the volume of water in the distillate. Azeotropes are some times claimed to be more convenient. This method is specially useful in the determination of moisture of semi-wet solids like organic fertilizers, clays, vegetables, fruits etc., and can be recommended as a quick and comparative method of determining the moisture.

The absorption method is a very general and accurate one for the determination of water in a variety of complicated systems including liquids and gases. In most of the cases an inert gas is passed over the material subjected to analysis and the moisture carried over is absorbed by a suitable desiccant. Even this method suffers from the temperature defect already pointed out and porous solids take long intervals for dehydration. Most of these defects can be overcome by use of vacuum for dehydration. The quartz spring method originally developed by McBain and his associates is perhaps one of the best methods of determining moisture in solids, both porous and non-porous. Since dehydration is carried out in vacuum, the rate of dehydration is high and comparatively low temperatures can be employed. An added advantage is that the amount of dehydration for any partial pressure can be accurately determined and hence ideally suited for studies on hysterisis in sorption.

Some of the physical properties have been employed in the determination of moisture but their use is very limited. Specific gravity, viscosity and refractive index are employed in the determination of moisture in a large number of binary mixtures where water is one of the components. The determination of refractive index can also be employed for the estimation of moisture in gases. The accuracy of their method depends upon the variation of the physical properties with the moisture content of the systems and also on the absence of other impurities that may interfere with measurement of these properties.

Critical solution temperature is also employed in the determination of moisture in liquids. This method is not only troublesome to employ as an analytical routine but also suffers from want of accuracy. Heat of dilution has been employed to estimate the moisture content of the acids while infrared spectrum is used to determine the water vapour in gases particularly in gaseous hydrocarbons.

By virtue of the simplicity of manipulation the measurement of electrical conductivity, resistance or dielectric constant is coming into vogue in the routine analysis for water in some commercial products like wood, textiles, ceramics, paper, tobacco, cereals, petrolium oils etc. This method appears to be very simple but in practice it requires elaborate precautions and standardisations.

A wide variety of chemicals have been employed for the determination of water, the following being some of the reagents commonly employed to react with water, metallic sodium, calcium carbide, calcium hydride, magnesium nitride, sodamide, methyl magnesium iodide, sodium ethoxide. The gases that are produced during the reaction are estimated either volumetrically or by other analytical methods. But invariably the results obtained are mostly qualitative in nature since this involves a reaction between the solid phase and the liquid.

Smith and his collaborators developed in 1935, a new and accurate method for the determination of moisture taking advantage of the hydrolysis of acetyl chloride in presence of pyridine but soon found that substances like aldehydes, amines, lower alcohols etc., interfere in the analysis. At about the same time Karl Fischer announced that a solution of iodine, sulphur-dioxide and pyridine in methyl alcohol could be employed for the estimation of water in a large number of systems. Smith and co-workers took up this piece of investigation and carried out very valuable work elucidating the chemistry of Karl Fischer reaction. Coming as it does from pioneers in this field of research work, the book "Aquametry" gives an authoritative account of the nature and mode of application of this important reagent.

The chief difficulty that presents itself in the use of Karl Fischer reagent both to the beginner and to the experienced analyst, happens to be the instability of the reagent even under the best of experimental conditions. Even a fresh reagent has only 80% of the theoretical potency. Realising this drawback the authors have spared no pains in describing in detail, the elaborate precautions that should be taken in the preparation and application of the reagent. Whatever may be the accuracy with which moisture in methyl alcohol can be estimated, the present method is bound to fail if the moisture is not quantitatively removed by the alcohol. In a good number of insoluble systems, the authors have given numerical data regarding the accuracy of the estimation of moisture as compared with the other standard

methods. The application of Karl Fischer reagent in the estimation of moisture in a large number of organic compounds has been described in great detail. In addition to the moisture determination, the use of the reagent to estimate organic functional groups like hydroxyl, amino, carbonyl, nitrile, etc., is dealt with exhaustively. The literature on the subject is collected upto the early months of 1947 and is quite comprehensive.

In their enthusiasm to stress the importance of the reagent the authors have not been quite critical on the efficiency of the reagent when applied to certain systems. The determination of water in silica gel can be quoted as an instance The moisture content of the gel by the Fischer reagent is 5·48% as against a value of 4·7% determined by drying the sample at 150° C. for 4 hours. It is well known that silica gel retains 4-5% water even after prolonged drying at 150° C. Hence it has to be concluded that the present method gives low values for moisture in silica gel. Similar low values are also obtained in the case of calcium sulphate It is thus obvious that the Karl Fischer reagent cannot be employed in the case of insoluble porous solids like silica gel or alumina where the solid surface has a great avidity for water. In fact anhydrous alumina can be employed to remove the last traces of water from alcohols!

The term "Aquametry" has been coined by the authors to represent 'the analytical process of water measurement ..... of materials'. The reader would then except a detailed and critical account of the several methods that are at the disposal of the chemist for the analysis of water. But it is sad to find that the authors have devoted only 16 pages for the review of various methods in "Aquametry". Methods where physical properties like density, refractive index and viscosity are taken advantage of in the aquametry, find only a passing mention in this dook. The reader would have deen greatly benefitted if the authors had devoted about 100 pages where a critical account of the existing methods for aquametry had been given in addition to the present information about Karl Fischer reagent. The present volume can more appropriately be called by its secondary title: "Application of the Karl Fischer Reagent to quantitative Analysis involving water."

In conclusion the authors have to be congratulated for placing such a detailed and authoritative account of the Karl Fischer reagent at the hands of the analytical chemists.

M. R. A.

PEST INFESTATION RESEARCH*

THE first report of the work of the Pest Infestation Laboratory of the Department of Scientific and Industrial Research, England, has been published by the H.M.S.O. on June 7, 1949.

The laboratory was organised in response to a request from Industry for research on pest control, as related to pre-War conditions; but since the laboratory was actually constituted only after the outbreak of War, war-time problems of importance in pest control were given high priority. The most urgent of the problems, was the bulk storage of grain for long periods and in environments which proved propitious for insect development. While the Ministry of Food's Infestation Control Division did the work of inspection of stored food and the application of appropriate control methods, the Pest Infestation Laboratory's task was to undertake research to enable the Control Division to operate efficiently. This meant getting to know all about the insects in relation to their food-stuff and the conditions under which it was stored. The work, therefore, involved biological studies of the insects and the mites and physical studies of the environment of the grain in bulk and in storage.

Three main lines of work that engaged the attention of the Pest Infestation Laboratory were— (1) Estimation of Infestation; (2) Development of control measures; and (3) Research on sprays. The estimation of the infestation of a given sample of grain was made possible by the improvisation of the "Carbon dioxide method", through which the "Carbon dioxide figure" for that sample could be worked out. Both the grain and insects infesting it produce together measurable quantities of carbon dioxide. Broadly the concentration of carbon dioxide found in the mass of grain stored is proportional to the number of insects present inside the grain. A related finding in this connection was that insects could and did cause grain to "heat" through the formation of "hot spots". Of the control methods developed, the fumigation of silo bins was the most important and is being used now on a very large scale. Re-

* Department of Scientific and Industrial Research, Rex-House, 4-12 Regent Street, London.