to which the alchemists had access could have produced any of these effects. We may be sure that they did seal up various things and subject them to heat, causing changes which they observed. The more fruitful way of looking at the problem is to ask why they *expected* such changes and why they symbolized them as they did.

What did a chemical change mean to the men of the Middle Ages ? It was essentially a generation of a new body and was thought of in terms appropriate to generation. There must be a marriage : gold must generate the seed of gold ; so gold, symbolized by the sun, must marry silver, symbolized by the moon. The character of the body produced in any generation was determined by the heavenly influences : the mercury of the philosophers was the physical condensation of those influences. The product was a seed : the seed must die in the ground, as the scripture tells, and from its black and putrefied remains springs the new being, the glorious body of the stone. The myth, if we may so call it, combines the two most potent ideas of man—the idea of marriage and the idea of resurrection and renewal. Is it surprising that the process fired the imagination of the artists ?

But why understand a physical process in such terms ? Man always desires to understand what he sees or conceives under some visual analogy. We have the atomic theory and conceive our chemical changes as the rebuilding of a structure. With a continuous theory of matter no such picture could be formed, and the human and spiritually oriented philosophers of the Middle Ages saw the chemical change under the analogy of the life of man. Man is generated and born, he dies to sin and is born again, he dies physically and is resurrected ; these transformations were what the medieval alchemist expected to see and supposed that he saw in chemical change.

Moreover, by a very characteristic reversal, the alchemists first constructed their view of chemical change on the analogy of man, and in later ages viewed man under the analogy of chemical change. Thus in the later years of alchemy, certain writers, notably Jacob Boehme, symbolized the mystical progress of man by the process of alchemy. The result is a fascinating equilibrium of chemical and mystical ideas, displaying a thousand shifting aspects to be exploited by the writer and his artists. Thus we expect and find in alchemical illustration not only figures of laboratory apparatus, but also every symbol that has a bearing on the ideas of transformation, marriage, generation, death, growth and renewal.

Both representational and symbolic illustrations are found in the alchemical manuscripts written in Greek, the texts in which were mostly written between A.D. 100 and 700. The Arabic manuscripts are, to my somewhat slender knowledge, but scantily illustrated, but certainly contain both elements. The elaborate series of symbolic pictures occurred in medieval manuscripts before they found their way into printed books, and it would seem that the more elaborate did not appear before the fifteenth century.

Printed alchemical books appear from the beginning of the sixteenth century. The first are distillation books, chiefly pharmaceutical, with alchemy taking a minor part. Some of these, such as the magnificent works of Brunschwyg, are illustrated by very fine woodcuts of a representational character. Symbolic alchemical works illustrated by woodcuts appeared at intervals throughout the sixteenth century ; but it is in the early seventeenth century that these attain their zenith. About the year 1625 there issued from the presses of De Bry and of Lucas Jennis a stream of finely printed alchemical books, adorned with finely conceived and beautifully executed engravings. As the seventeenth century proceeded, alchemy and chemistry achieved their separation. Chemical works with good plain pictures of apparatus abounded, though these commonly retained some alchemical matter and often a symbolic frontispiece. By the close of the seventeenth century, alchemical illustrations had disappeared from chemical textbooks, while the alchemical works, still produced in great numbers, displayed more of the influence of Rosicrucianism, the Cabala and Free-masonry.

We learn a not insignificant part of the history of chemistry by studying alchemy and its pictures ; also our eyes are opened to a view of the world other than the modern scientific—a view which we may regard as a horrifying example of unscientific thinking or as the addition of a poetic and human quality to our outlook on material things. Moreover, we learn something about man, his eternal problems and aspirations, and the manner in which desires and ideology affect his very observations, let alone the interpretation he gives them. We cannot view the scientific way of thinking truly except by a contrast with non-scientific thinking about the same subjects, a contrast for which the Exhibition now at the Science Museum provides material.

OBITUARIES

Sir James Irvine, K.B.E., F.R.S.

WITH the death, on June 12, of Sir James Irvine, principal and vice-chancellor of the University of St. Andrews, this ancient seat of learning mourns the loss of an illustrious son whose career at St. Andrews extended over a period of fifty-seven years in the successive capacities of student, lecturer, professor and principal. His services to the University, particularly during his tenure of the highest office for more than thirty years, can truthfully be described as inestimable. In that period he changed the face of the University and brought prosperity and high prestige to a time-honoured academic foundation which in his early days was marked by poverty, a paucity of students, and a lack of proper buildings and equipment for the teaching of science.

James Colquhoun Irvine was born at Glasgow on May 9, 1877. After his early education at Allan Glen's School and the Royal Technical College, Glasgow, he entered the University of St. Andrews in 1895 and graduated B.Sc. in 1898. Here he became a brilliant disciple of Thomas Purdie, professor of chemistry, who always remained in his memory. It was during an ensuing period of study under Wislicenus at Leipzig that he conceived the novel idea of applying Purdie's method of methylation to the investigation of the molecular structure of carbohydrates. From this idea sprang the famous carbohydrate research school at St. Andrews, which he developed with so much energy and success during his tenure of the chair of chemistry from Purdie's retirement in 1909 until his own appointment, in 1921, as principal of the University. These pioneer researches led to later work of the first importance in carbohydrate chemistry, much of which was carried out at Birmingham under the direction of Sir Norman

Haworth, who had formerly held an appointment in Irvine's department at St. Andrews.

Irvine's researches were interrupted by the First World War; at the same time, however, the experience of the St. Andrews school was brought into full play in meeting the demands of the British, French and Russians for such indispensable carbohydrates as dulcitol, inulin, fructose, maltose and mannitol. There followed the complete preparation, in quantity, of novocain. These tasks, together with difficult and dangerous work on mustard gas, hindered the expansion of the fundamental researches on carbohydrates. This work was once more getting into stride when Irvine became principal in 1921.

Soon afterwards, the scientific contributions that the new principal had made to the national war effort were recognized by the bestowal upon him of a knighthood; he had been elected a Fellow of the Royal Society in 1918. A portrait of this fourth professor of chemistry in the United College of St. Salvator and St. Leonard, painted some years later (1933) by Oswald Birley, hangs in the Senatus Room of the University of St. Andrews beside that of his teacher, predecessor and friend, Thomas Purdie. A distinguished pupil of Irvine has said that "he was an inspiring teacher, and his lectures were models of clearness. More than that, they inspired in the students a love of chemistry and gave them a desire to take part in the discoveries that Irvine himself was initiating".

Irvine had shown his administrative ability as professor and also as dean of the faculty of science; but few suspected his latent powers until the broad opportunities of the principalship unfolded themselves before him. A profound love for his University and an unfailing faith in its high destiny enabled him to combine the vision of the seer with the drive of the man of action, and to use tradition as the handmaid of progress and development. He cherished the picturesque attributes of his ancient University, and drew into practical service the pageantry and colour of the 'College of the Scarlet Gown'.

During his long term of office, the development of the residential system with its attached Harkness entrance scholarships, together with the institution of regents, played a leading part in widening the field of recruitment of students and in raising their number to an economic level. New chairs were founded judiciously in every faculty of the University. Among many notable advances in the part of the University situated in Dundee were the growth of the schools of medicine and engineering, and the expansion of the chemistry department of University College. These rapid developments, combined with the geographical handicaps imposed upon a University with centres situated upon both sides of the Tay, have inevitably given rise to growing pains. Such difficulties, however great, must be overcome in the interests of the University as a whole. In Irvine's own words (1950): "Let it be an encouragement and an inspiration to each one of us to reflect that, within the history of our own times, obstacles so formidable have been met and surmounted. . . . I have faith, unconquered and unconquerable, in the beloved University of St. Andrews".

Irvine's interests and activities, although concentrated upon the University of St. Andrews, spread outwards in ever-widening circles as the years went by. He took a great and practical interest in preserving the historical character of the city of St. Andrews. In the outside world he rendered invaluable services to the Scottish Universities Entrance Board, the Scottish Education Department, the Forest Products Research Board, the Carnegie Trust, the Pilgrim Trust, the Commonwealth Fund, and many other organizations. He was a member of the Prime Minister's Committee on the Training of Biologists (1931), chairman of the Viceroy's Committee on the Indian Institute of Science (1936), of the Committee on Higher Education in the West Indies (1944), and of the Inter-University Committee on Higher Education in the Colonies (1946–51). He was a prime mover in founding the University College of the West Indies, where the scarlet student-gown of St. Andrews may be seen in a new environment. He was also an ever-welcome visitor to the United States; on various occasions he delivered special lectures and addresses in that country, as at Williamstown (1926), Princeton (1929), and Yale (1931).

He was awarded many honours: in 1948 he became K.B.E.; in chemistry he was Longstaff medallist of the Chemical Society, Davy medallist of the Royal Society, Willard Gibbs medallist of the American Chemical Society, and Elliott Cresson medallist of the Franklin Institute of Pennsylvania. He received numerous honorary degrees from the universities of the homeland, the British Commonwealth and the United States.

He married in 1905 Mabel Violet, younger daughter of Mr. John Williams, of Dunmurry, Co. Antrim. Throughout his subsequent career he owed much to his wife's unfailing devotion and counsel, and to the background of a happy home-life. He had three children, including one son, Nigel, who died on active service during the Second World War.

It is difficult to do justice in words to Irvine's many-sided character and personality. A richly stored mind found expression in speech that could attain a rare eloquence and charm, whether at great moments or upon more intimate occasions. He was an admirable chairman, ever ready to lighten the routine of business with an apt anecdote or reminiscence. He had a remarkable power of reducing a complicated problem to its essentials; at the same time, he had an equally remarkable memory for detail of all kinds. Persuasive in argument, tenacious of opinions carefully formed, he showed the greatest determination and forcefulness in carrying through a cherished project passionately held. He was a stern disciplinarian when occasion demanded; yet his students knew instinctively that in him they had a firm friend. He had, indeed, a discerning sympathy with youth; he would sometimes pause at his desk in the midst of the weightiest matters in order to write a charming letter of encouragement or of congratulation to a youthful acquaintance: from him came many kindnesses of which the world knew nothing. In himself he preserved throughout his life a certain element of spiritual boyishness, allied closely with his eager zest for new knowledge and fresh experiences.

Two years ago Irvine wrote: "I find myself—a twentieth-century scientist—gazing across the chasm of five hundred years to a strange remote world and am conscious afresh of a feeling which never entirely escapes me that, as the thirty-fourth Principal of St. Salvator's College, I am privileged to share in the inheritance of a solemn trust; at once I am brought face to face with the question if the duty committed to that long succession of Masters has been faithfully discharged". The answer is clear to us and will be even clearer to posterity.

John Read