(2) So that this plane is perpendicular to the field.

If we are able to calculate the refractive indices on these data, then it must be possible to find conditions governing the arrangement of the atoms, when we know the composition of the crystal and its refractive indices. For instance, the near equality of the refractive indices of potassium sulphate implies that the dielectric capacity of the SO_4 group is much the same in all directions, and this is in agreement with the hypothesis that the oxygen atoms are grouped in some sort of tetrahedral fashion about the sulphur atom.

There are still other connections between structure and properties which we begin to understand, and can use in proportion to our understanding. The cleavage plane, and the occurrence of certain faces in preference to others are connected with the nature of the bonds and the size of the spacings. We are not surprised to find that in bismuth or graphite or naphthalene the cleavage plane cuts across the ties which we should expect to be the weakest of those that bind the molecules together; or again, that natural faces follow the planes that are richest in atoms or molecules and may be assumed to contain relatively large numbers of linkages. In naphthalene the cleavage plane passes between the ends of the molecules, where the β hydrogens are, and where there is a deficiency in the number of scattering centers, as the X-rays indicate by the strengths of several orders of the (001) reflection. The other faces found on the crystal cut across the ties at the positions of the α hydrogens.

There are many other connections between the structure and other properties of a substance, such as dielectric capacity, rigidity and compressibility, conductivity both thermal and electric, magnetic constants. In fact, the only properties of solid bodies which are not directly and obviously related to crystal structure are those, few in number, that depend on atomic characteristics alone, such as weight; and the absorption coefficients for α, β, γ and X rays, all the rays which involve high quantum energies. With few exceptions every aspect of the behavior of a solid substance depends on the mode of arrangement of its atoms and molecules. We have, therefore, an immense field of research before us, into which the X-ray methods have provided an unexpected and welcome entrance.

They tell us directly, as I have said, the number of molecules in the crystal unit cell, and the mode of their arrangement with such determination of lengths and angles as are required to define the mode of arrangement in full. They leave us then to ally our new knowledge to all that we possess already as to the physical and chemical properties of substances. By this comparison we hope in the end to determine the position of every atom, and explain its influence through its nature and position upon the properties of the substance. It is the chemistry of the solid that comes into view, richer in its variety even than the chemistry we have studied for the past century, and possessing an importance which is obvious to us all. Every side of scientific activity takes part in this advance, for all sciences are concerned with the behavior of matter.

W. H. BRAGG

REMINISCENCES OF LORD KELVIN

ON the hundredth anniversary of the birth of Lord Kelvin, celebrated by the scientific world, it may be permitted for the writer to record personal experiences of his kindness and impressions of his interesting personality.

When in England among the scientists in the late eighties of the last century, it was most gratifying to receive from Lord Rayleigh a letter of introduction to Sir William Thomson. When Lord Rayleigh came to America to attend a meeting of the British Association in Canada, he visited the laboratories of Wellesley College and was graciously disposed to put in the way of the first woman undertaking a department of physics in a college access to the best in her subject in England.

Though it was summer and vacation in the University of Glasgow, there was received from Lady Thomson a cordial letter, stating that she and Sir William were to come up from their country place in Ayrshire to assist in doing the honors in the university for the British Medical Association, then in session. She enclosed a card of invitation to the reception to be given to the medical men and asked me to come at nine o'clock to go with them.

At the appointed hour I was welcomed by our host, a man of quiet, almost quaint appearance and manner, but shining from his kind eyes a winning friendliness. Lady Thomson, in garnet velvet, tall and handsome, quite resplendent with pearls and diamonds, stood beside him. The reception was in the stately Gothic senate chamber, lately given to the university by the Marquis of Bute. All the faculty in academic dress and the ladies were gathered on the daïs.

After being presented to Principal Caird and others, from a point of vantage amid the brilliant group, one saw all Glasgow, much of Edinburgh and the British doctors file past.

It was evident that Lady Thomson was the acknowledged social leader, and that Sir William was the one whom all the guests were most eager to meet.

The next day several memorable hours were spent

in the laboratories, where much was going on. Half a dozen alert young students, some of whom have since become distinguished, were at work; here they were hands and feet under the control of the master mind, trying one device and then another to overcome difficulties in the performance of instruments later perfected. I sat by and watched how the mind of the original investigator works. His luminous face was an interesting study. Later he explained the evolution of his quadrant electrometer and siphon recorder, showed early models of cable devices and told dramatic experiences on his three Atlantic cable-laying voyages.

He told of Maxwell's great works—said he had not mastered all his equations yet—"I took a pull at them after returning from the reception the night before" he added. Lady Thomson showed the note-books he always kept about to catch new ideas or develop old ones; sometimes these were called to service in the night, which reminds one of Emerson, who used to wake up his wife because he had a thought. Sir William took me to his lecture room; showed his shoemaker's-wax experiment, in which the lead bullets from above and the wooden cubes from below were working their way through, as he conceived the earth ploughs through the ether. He showed his "secular experiment," as he called it, which he said was to go on for a hundred years to show the rate of travel of molecules. One wonders if that long tube is still on the wall of the Glasgow laboratory.

Going to the house for tea, the African parrot was introduced—"Dr. Red-tail, alias Parnell or Donnelly, because he is an obstructionist, and if he can not have his way makes it impossible for others to have theirs."

Sir William talked of Scotch history, of Prince Charlie and Jacobite music, of Highland legends, of American politics.

In contrast to many other English and German scientists, Sir William seemed neither surprised nor alarmed that a woman should devote herself to mathematics and physics. This was thirty-five years ago.

Some months later the meeting of the British Association of Science was at Bath. It was an epochal meeting, for the work of Hertz, showing the identity of light and electricity, thus verifying the prediction of Maxwell, was just being discussed and "Section A" was full of excitement. The American stranger was taken under the kind care of Lady Thomson, who was always at her husband's elbow, correcting his proof or amending his absent-mindedness, saying, "Sir William, here is so and so, you must meet him."

Through their kindness a dinner at the beautiful home of their host, a nephew of John Bright, was enjoyed. It was worth while to listen to the brilliant conversation between Sir William and Jannsen, the distinguished French astronomer, Oliver Lodge, Glazebrook and other like guests.

After ten years it was again my good fortune to be at another notable meeting of the British Association at Liverpool. The x-rays had just been discovered, and Lenard, who did the pioneer work, was a guest of honor. It was here a sidelight on the personality of Lord Kelvin, for he had now been elevated to the peerage, to see how all the Englishmen of science not only revered but loved him.

To hear the veterans, Kelvin and Stokes, in high debate with other giants of science as to the "particular go" of the half dozen new kinds of radiation lately discovered was something to remember.

Lord Kelvin asked me to a private séance with Lenard and his tubes. His child-like ingenuousness was delightful. While every one was hanging on his words, his attitude was always that of the questioner and learner.

This was deeply impressed in the final experience I had with Lord Kelvin. He was to lecture in Faraday's Theater in the Royal Institution in London. Professor Dewar sent tickets and an invitation to a reception given at his house after the lecture. It had became a rare thing for Lord Kelvin to lecture, and a notable audience was gathered from all the universities to honor the occasion. Every one was in full dress, as is the wont at these famous Friday evening lectures. The semi-circle of men fronting the lecturer was remarkable, every man of international reputation—Lord Rayleigh, who discovered argon, Ramsay, of helium fame, Crookes, of the cathode rays, Huggins, "father of the new astronomy," and a score of others almost as noted. Lord Kelvin spoke slowly, with singular unconsciousness of his audience. He seemed to be rather thinking aloud and watching his experiment with intent look and uplifted finger, looking for the result as if to learn something new himself.

Lord Kelvin was great enough to lead the mathematical physicists of his day and kind enough to give the inspiration of his talk, and answer patiently the questions of eager young students.

SARAH FRANCES WHITING

SCIENTIFIC EVENTS

THOMAS CORWIN MENDENHALL

A MEMORIAL to Dr. Thomas Corwin Mendenhall, prepared by the committee on necrology, was presented at the meeting of the Ohio Academy of Science at Columbus on April 19, by Professor Herbert Osborn. The memorial reviews Dr. Mendenhall's life and services to science, which were the subject of a special article by Mr. G. R. Putnam