emits or absorbs light in bursts called photons or quanta. The frequency of the light is proportional to the difference in the energy of the two levels, and therefore when the spectrum of a gas is examined it shows patterns of bright sharp lines.

In a solid, however, the atoms are closely bound to each other; as one result of this the energy levels of the electrons are smeared into overlapping bands within which an electron can have virtually any energy. The spectra reflect the situation by appearing in bands instead of lines.

An important key to the electronic structure of a solid would be the ability to see detail within these bands. This has not proved easy, but with quantum magnetooptics it becomes possible, according to Dr. Benjamin Lax of the Francis Bitter National Magnet Laboratory in Cambridge, Mass. Dr. Lax reported on progress in the field to the Optical Society of America at its spring meeting in Washington, D.C. *(See p. 314).*

Magnetic fields interact with electrons by way of the magnetic fields the electrons themselves generate. An electron in an atom, for example, generates a small magnetic field by going around in its orbit.

If a fairly weak external magnetic field is imposed on a sample of gas, the phenomenon known as Zeeman effect results. The external field exerts force on the electron fields, trying to bring them into line with itself. The orbital motion of the electron opposes the disturbance and the result is compromise—a rotation of the electrons' fields around the external field at an angle determined by the specific conditions of each situation. Since those conditions have discrete values, only certain discrete angles can result.

Each possible angle has a slightly different energy, so that each original nonmagnetized energy level is now split into several closely spaced ones.

The electrons now have several possibilities for energy transitions where only one existed before, and this shows up in the spectra by the splitting of previously single lines into several closely spaced ones.

The high magnetic fields of quantum magnetooptics, Dr. Lax reports, provide a solid-state analogue of the Zeeman effect. As he puts it, the high fields have an effect on the broad solid-state bands similar to that of the weaker fields on the gas spectral lines.

What happens when a very pure crystal is placed in a high magnetic field (and cooled to liquid nitrogen temperatures to minimize noise produced by thermal vibrations), is that peaks and valleys appear in its spectrum.

The effect of this requantification is to permit resonant absorption, that is the selective absorption by solids of quanta with certain precise frequencies. Resonant absorption is characteristic of gases because of their sharply defined energy levels and is one of the most important means of detailing their atomic structure. In solids it should yield detailed quantative information about the interactions of electrons with each other and with the ion lattice that forms the foundation of the crystal.

An example of the sort of solid-state prescriptions that may become possible is a search for a thermoelectric converter being conducted by Dr. Lax and his colleagues. In principle a system that converts heat directly to electricity can be competitive with other means of power generation. The practical trick is finding a substance that will do the job with proper efficiency.

None is yet known, but the investigators have found that they need a material with the electronic properties of lead telluride, but not its crystal structure, and the thermal properties of germanium. "In the end we may have to invent it," says Dr. Lax.

IEEE

Accenting the nontechnical

For the 65,000 engineers who swarmed into New York last week for the annual meeting of the Institute of Electrical and Electronic Engineers, reports on research and development, as represented by technical seminars, were apparently of marginal interest.

In the first place, a field so closely connected to commercial production doesn't usually announce many technical discoveries until they are packaged in walnut with a price tag attached. Second, with an organization so large, and including so many diverse specialties, a narrow technological report could appeal to only a tiny fraction of those attending.

Recognizing the problem, the IEEE this year instituted a more general aim in its technical sessions, tying engineering into other areas in an attempt to find subjects that would appeal to a cross-section of the membership.

Discussion groups were held on, among other subjects, the role of electronics in transportation systems, proposed changes in the patent laws and problems raised by electronic eavesdropping devices.

Even where technical subjects were discussed, the papers presented were more of the wrap-up, where-are-we-now kind than reports of specific technical progress.

An example was the seminar on solid state technology in which four engineers brought a large audience up to date on the prospects for semiconductors, magnetic devices, piezoelectric systems, and superconductive applications. The conclusion seemed to be that cryogenics, in which metals are lowered in temperature to the point where they have practically no electrical resistance, has the most promise in the future.

"I suggest we all go out and buy helium mines," concluded session chairman S. K. Ghandhi of the Rensselaer Polytechnic Institute.

Despite the new policy on session topics—which seems to be successful, since the sessions were well attended—the technical program was small for such a large meeting. Only 49 sessions were held in the four-day meeting, far fewer than the less populous but more technically oriented meetings of other professional groups. Probably only a tenth of those at the convention attended technical meetings.

A bigger drawing card was the technical exhibition.

This year saw a decrease in the big splashy displays—several companies, reflecting poor business last quarter, cut down on exhibition space. The result was that a lot of smaller companies moved into the available space, and were represented for the first time.

The large-company disenchantment with the show reflected the hard fact that few sales are ever made there. Display booths are more a form of advertising, say the exhibitors, but worth watching to find out what the competition is coming up with.

Another popular activity in New York last week was job hunting. Although frowned on by the IEEE management, the annual gathering of talent inevitably becomes an opportunity for recruiting, to the point that some small companies are reluctant to send good men to the meeting for fear they will be snapped up.

Unlike some professional societies, which set up placement bureaus at their annual meetings, the IEEE prohibited recruiting at the headquarters hotel, the New York Hilton, and at the Coliseum where the exhibit was held. But most companies set up recruiting suites in nearby hotels.

Demand for engineers was strong and salaries were about four percent higher than last year, but recruiters seemed pleased with the prospects they saw.

New draft rules for graduate students introduced an uneasiness among prospective employers, but the draft's real impact will show up next year.

(Science News will carry the meeting's technical highlights next week.)