emission from crystallite to crystallite. The curve of conductivity as a function of temperature showed three different slopes for the temperature ranges, less than 700°, 700–800°, and above 800° K., the values agreeing with those previously reported. In discussion, the need for consideration of much simpler substances was emphasized as well as the elimination of uncontrollable variables, and it was suggested that magnesium oxide would be the easiest oxide to study since large single crystals have recently become available.

Photo-conductivity of the lead sulphide type of semiconductors attracted some discussion, especially as the literature appeared to indicate that the method of preparation of the lead sulphide films affected considerably their photo-conducting properties. It was suggested that the lead telluride type of cell should be studied since its production does not involve contamination by oxygen, etc.

The final session of the Conference was devoted to an exhibition of properties and applications of semiconductors, many of which had been discussed in the main sessions. A clutch using the Johnson–Rahbeck effect was shown using polished magnesium titanate in contact with polished brass, as well as a lead sulphide cell showing the high temperatures reached at hot spots at frictional contacts.

The papers and discussions made clear the growing interest in the theory and applications of semiconductors, and directed attention to the work proceeding in government, industrial and university laboratories. Some of the papers presented will lead to contributions to other journals.

W. Grattidge
F. A. Vick

SELECTION OF STUDENTS FOR UNIVERSITIES

On the morning of September 14, Section L (Education) of the British Association discussed "Selection at the University Level". Mr. W. O. Lester Smith, president of the Section, presided.

Mr. J. O. Roach spoke from experience of the Civil Service Selection Board, and previously as a Cambridge tutor. He said that some well-known modern methods of selection depended essentially on a careful job analysis. But in the case of university students, for what were we selecting? For success in examinations, for success in life, or for what? There was no one criterion and therefore no one method of selection. He felt strongly himself that there must on no account whatever be any interference with those of exceptional intellectual powers; no non-academic criterion must be allowed to exclude these. Also he was against a health test—too many men of intellectual distinction had suffered from poor health since the beginning of the world. Forecasts of employability, too, were extremely difficult to make successfully. We must not exaggerate the ill-success of the present method; at least it satisfied public opinion as non-political and generally fair. Still, methods of selection were certainly an important problem, now that there was hope that all, or nearly all, the boys and girls of ability in the nation would reach the sixth forms of schools; and the dissatisfaction with to-day's students expressed by Lord Lindsay of Birker in the House of Lords had met with wide agreement. Mr. Roach emphasized that the need for a new approach was being widely recognized in the universities; and he warned the meeting against assuming that there was any one quick and easy solution to be found.

Mrs. J. L. Stocks found wide agreement among those present with views she had formed from her experience at Westfield College, London. There she had, with very small exceptions, been concerned only with honours women students for arts subjects. She thought that there was a serious danger of paying too much attention to the requirements of the various professions, and too little to the quality of life inside universities. She was herself impressed with the qualities of to-day's women students, who were drawn from a wider range than the students of the '90's, with their cultured, keen but rather narrow backgrounds. In the sixth forms of schools nowadays, the girls had done all sorts of things outside formal classes, from dramatics and foreign visits to conferences on world citizenship and the organising of national savings. They had their shortcomings, of course; some of them, for example, had no idea how to talk to a stranger or how to go away from a party.

As for the present system of selection, Mrs. Stocks said there was rather an absence of system. The anxious queueing for Somerville, Westfield and other residential colleges was a ridiculous arrangement, infuriating for the selectors and very bad indeed for the adolescent selectees. She thought that any better method of selection would be likely to involve some degree of conflict with hitherto accepted individual liberties; but this might have to be accepted. A final solution might well take time to find, as the encouraging success of social democratic education was still a new thing. At all costs, universities must remain academic communities, and not become, for example, mere schools for leadership.

Mr. C. R. Morris spoke as a headmaster. He did not believe that the selection of individual students was the most important problem to-day, urgent as it was. The universities appeared to be dissatisfied with nearly all the students they were admitting, and not just with the small percentage of the total body who might be different if the system of selection were different. As a result, many people seemed to be toying with the idea that able boys ought to continue right up to the age of eighteen with work of the general type of school certificate work. If this were really intended, it would be a very serious mistake. It had been a great triumph on the part of the grammar schools to lead so many good students to the doors of the university and make the present university expansion possible. It must not be supposed that all able boys *wanted* to go to the university. Outside the professional and near-professional classes, this was far from being the case. In the other sections of society, it was the schools which had to do the missionary work, and without doubt it was by their sixth-form courses that they succeeded.

Moreover, this sixth-form work, Mr. Morris claimed, was in principle educationally sound. After reaching the age of fifteen or so, an able boy, whose contemporaries were starting on their working careers, needed to feel that he was beginning to become a real scholar or expert in the group of studies for which he had the best aptitude. This gave him his initiation into the commonwealth of learning. Certainly his work in his special field ought to have a less crowded syllabus than at present and give him more elbow room to explore for himself; and outside

his special field he should give a third of his time and energy to the continued study of the use of English and to the discussion of general problems, cultural, religious and social. Discussion really came to mean something if each boy could contribute to it on the basis of his own expertise and hear his friends do the same. Ideally, sixth-form work, outside the subjects of special choice, should not be subject to external examinations. It was necessary here to exploit idiosyncrasies in the teachers, not to steam-roller them. The most important single thing was a real understanding between teachers and schools, and this would now be perfectly practicable if it were set about in the right way.

In the course of an interesting discussion, Mr. Clegg made the point that local education authorities had in effect asked the universities to organise through the joint matriculation boards the selection of students for financial grants, and the universities were now criticizing the students selected. The remedy, he thought, lay in the hands of the universities themselves.

The president of the British Association, Sir Henry Tizard, said that in his view university teachers should recognize that they were not experts in the education of schoolboys and schoolgirls, and should leave this to the schools. University students must be in the upper range of intelligence and must *want to do something*. Intelligence and zeal—provided students had these virtues on entering the university, it did not matter what subjects they had been taught at school.

A number of speakers emphasized that public opinion did not sufficiently appreciate the part that ought to be played in the higher education of the nation by technical colleges. It was most short-sighted to allow these to continue to fall so far short of the universities in prestige.

MORPHOLOGICAL ASTRONOMY

THE Halley Lecture for 1948, with the above title, was delivered at Oxford on May 12 by Dr. F. Zwicky, of the California Institute of Technology, Pasadena. The lecture covers such a wide range in astronomy that only the more important points can be referred to in this short summary; fuller information can be obtained from *The Observatory* (**68**, 845, August 1948), where it is printed in full.

The morphological method is merely an orderly way of looking at things, and its essence is direct thinking and direct action—a combination which is a great asset of free men and of the democratic way of life. A complete morphological analysis of astronomy is a very comprehensive undertaking, and Dr. Zwicky discusses only some of the basic elements of such an analysis, among which he includes the following: observation of celestial phenomena; experimentation with celestial phenomena; theoretical integration; use of the knowledge gained in construction; dissemination of the knowledge and its bearing on all activities of man.

Under the first of these headings, Dr. Zwicky deals with the instruments to be used for observation and gives a very brief description of the photo-electronic telescope, which has introduced a number of new features. Even with such telescopes of relatively limited definition and light power, the search for novæ, supernovæ, variable stars, comets, meteors, etc., can be put on a 'mass-production' scale because images from photo-electronic telescopes can be televised. Another of the different advantages of this telescope is the ability to steady moving or scintillating images resulting from unsteadiness of the atmosphere or motions in the telescope, and automatic guiding of the telescope can be accomplished through devices similar to those used for steadying the refocused image on the recording surface.

Reference is made to the devices for observing phenomena from points above the main portion of the earth's atmosphere, by the use of rockets carrying scientific instruments. V2 rockets have already carried various instruments to heights exceeding 200 km., and it is proposed increasing this range to 1,000 km. to eliminate the greater portion of the atmospheric absorption. There are visions of vehicles carrying observers to great heights, and even the high-flying conventional aircraft have possibilities in this direction which may some day be exploited.

The accomplishments of the 18-in. Schmidt telescope on Palomar Mountain during the last ten years are dealt with, and important results mentioned refer to work on clusters of nebulæ, nebulæ, stars, supernovæ of various types, common novæ, very blue faint stars, and the general theory of relativity and the theory of the expanding universe. In connexion with this last subject, it was proposed that compact nebulæ acting as gravitational lenses could be used as a check for the deflexion of light, and the idea of nuclear matter of a density of the order 10^{14} gm./c.c. was also suggested. Such matter, which should exist in neutron stars—perhaps ancient remnants of supernovæ—would act as gravitational stars *par excellence*, and it is intended to make a determined search with the 18-in. Schmidt. Bright supernovæ supply data for some interesting conclusions on nuclear chain reactions, knowing that such bodies emit during the first 200 days about 5×10^{48} ergs in the form of visible light. For a star of mass 100 times that of the sun and containing about 10^{59} protons, the energy liberated per proton is, therefore, much greater than the maximum energy liberated per proton in the most energetic chemical reaction. There is, therefore, some justification for the conclusion that in a supernova outburst there is a nuclear chain reaction attended probably with a gravitational collapse to nuclear matter. Some supernovæ, notably the object NGC 4636, have been caught on the rise, and in such cases the speed is in accord with the assumption of nuclear chain reactions. As Zwicky remarks, "We here therefore have one more example how apparently academic astronomical observations led the way to the discovery of phenomena of the greatest import". A short investigation suggests that there is the possibility that cosmic rays are generated in supernovæ.

Astronomical knowledge has been used in the past for the conduct of human affairs, and an extrapolation of these applications, which lies in the line of morphological thinking, is a reconstruction of the universe, in which that of the earth comes first. This is of fundamental importance as there is the danger that the whole earth might be exploded by large-scale nuclear chain reaction, and schemes for stabilizing the earth against such an eventuality are part of morphological astronomy. Possibly there will also be plans for making some of the planets habitable by changing them intrinsically and by altering their positions relative to the sun; and however fantastic such schemes may seem, Zwicky suggests that these