away from one of the obvious aiming points for hostile missile launchers. Architects, users and the general public will be glad that the laboratory and its principal architects, Smith, Haines, Lundberg and Waehler, have been able to resist the suggestion of the General Services Administration that the whole complex should be accommodated within a single structure.

The site at Gaithersburg was chosen a decade ago. Planning and construction have been informed by the view that reconstruction was an opportunity "to create facilities that would not only serve the Bureau for the present but would be flexible to meet the needs of the rapidly changing fields of the physical sciences for many years to come". The total cost of the new installations is expected to be $120 million, nearly a third of which has been spent on seven general purpose laboratories each of which occupies a rectangular plot of ground 105 ft. by 385 ft. and which rises three stories and an attic above the ground. Three storied corridors connect the seven buildings together at the corners, so as to retain some advantages of the old dream of a monolithic building. Room has been found within them for the long tunnel-like rooms with which metrologists work, and there will be opportunities for the Building Research Laboratory to build real houses on the undisturbed earth which forms the floor of the Environmental Engineering Laboratory. Elsewhere on the site are a nuclear reactor of high flux (which operates at 10 MW and has a maximum flux of 10^{14} neutrons cm^{-2} sec^{-1}), a laboratory for radiation physics equipped with a linear accelerator, and a structure intended for particularly hazardous experimental work. The Engineering Mechanics Building will house a universal deadweight testing machine which will be used for calibrating load cells and other similar devices, and which is accurate to 0·002 per cent.

The move to Gaithersburg comes at the end of a decade of sustained growth for the NBS, during which the operating budget has increased three-fold to roughly $60 million. The total staff, at Washington and at Boulder, amounts to roughly 4,500, a third of them professionally qualified people. The pattern of the interest at the laboratory is continually extending beyond standards and metrology, and in the past few years particular attention has been paid to the development of what is called the National Standard Reference Data System, which is a plan to compile critical data in all fields in the physical sciences. In this as in its other work, the NBS is closely in touch with laboratories elsewhere.

Nobel Chemistry: Prof. Robert S. Mulliken

PROF. C. A. COULSON writes: The award of a Nobel Prize in chemistry to Prof. Mulliken is a fitting recognition of his role as one of the pioneers, first in the unravelling of molecular spectra, and then in applying wave mechanics to almost every aspect of molecular structure. Robert Sanderson Mulliken was born in Newburyport, Rhode Island, seventy years ago. His first degree was in chemistry, at the M.I.T., but for the past 35 years he has been at the University of Chicago, chiefly in the Ryerson Physical Laboratory.

Mulliken's most important early work was the recognition that the electrons in a molecule could be assigned quantum numbers, in a manner very similar to that already accepted for an atom. This led to the idea of molecular orbitals analogous to atomic orbitals for atoms. Together with Hund, Huckel and Lennard-Jones he established the molecular orbital theory, now almost universally used in accounts of molecular structure. Electronic spectra followed, for it was an easy step to interpret the absorption and emission of light as the result of the quantum jump of an electron from one molecular orbital to another. Even today this remains the basis of all interpretations of the colour of a molecule.

But what about the shape, or the form, of these molecular orbitals? (Even the word orbital itself is due to Mulliken, together with a good many other such descriptive labels.) Basing his conclusions on some studies made by Bloch for metallic solids, Mulliken expressed each molecular orbital as a linear combination of atomic orbitals; so that now the abbreviation LCAO is part of the accepted shorthand in this field. This LCAO approximation provided a theory of valency, and a link with the Pauling theory of electron pairs.

The particular combinations of atomic orbitals that can occur in this representation are not arbitrary; because the symmetry of the molecule imposes limitations. In discussing this situation Mulliken was able to take over the work of Bethe on solids, and introduce into molecular structure the elegant methods of group theory. A very large and growing literature shows the widespread consequences of this idea. The symmetries of the molecular orbitals settled the selection rules, and with a little additional guidance, the absolute intensities of electronic bands could be estimated.

Mulliken's interests have extended further. He is the chief exponent of the charge–transfer theory of molecular complexes, and one of the originators of the concept of hyperconjugation. More recently he has been busy interpreting the Rydberg spectra of molecules.

Prof. Mulliken's work in molecular structure represents an astonishingly continuous and sustained study. No one, with the possible exception of Linus Pauling, himself a Nobel Prizewinner, has made contributions so numerous and fruitful in the study of molecules. His is one of the few names that will always be associated with this field.

Nobel Physics: Prof. Alfred Kastler

THE Nobel Prize in physics has been awarded to Prof. Alfred Kastler (64), who directs a group of research workers at l'Ecole Normale Supérieure in Paris. His work on optical pumping made possible the invention of the laser; he was awarded the prize for "the discovery and development of optical methods for studying Hertzian resonances in atoms".

The difficulty with this type of optical pumping is that light of sufficient spectral purity is not available: Kastler's work in collaboration with Bitter and Brossel circumvented this difficulty by using polarized light and taking advantage of quantum mechanical selection rules to depopulate either energy level. The principle of optical pumping, apart from its use in the laser, has also been used in very sensitive magnetometers and atomic clocks.

Prof. Kastler has not always been in political sympathy with the authorities; he has consistently opposed the making of nuclear weapons and the French nuclear weapons programme. His support of dissenting causes during the Algerian war led to a bomb attack by