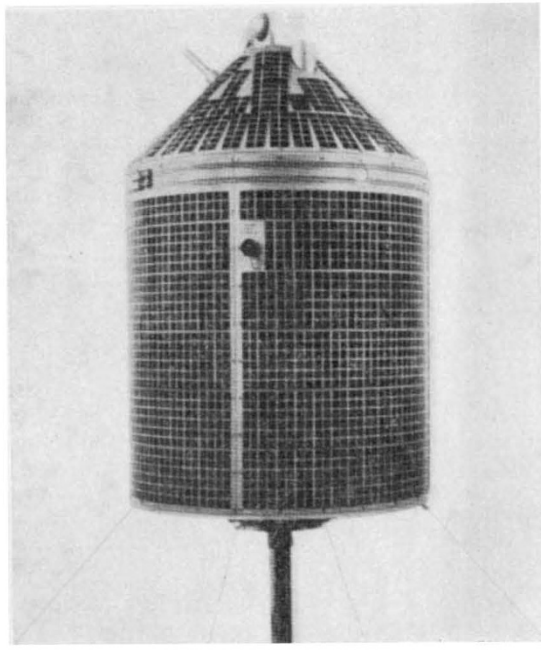
was due to be launched by a Scout rocket from the Western Test Range in California on November 6. A symbol of West Germany's burgeoning space programme, the satellite is the final phase of an agreement between NASA and the German Ministry for Scientific Research which was signed in 1965. The agreement allowed for a series of rocket and balloon flights to prove the instrumentation of the satellite, and these were carried out from sites in Canada, Sweden and Brazil during 1966 and 1967. There has been no exchange of funds between the two nations—NASA has provided the sounding rockets and the Scout launcher free.

Although Germany's contribution to the European space programme is expected to remain more or less steady at about DM 150 million into the 1970s, there is to be an enlargement of the national programme which must be the envy of space scientists in France and Britain. Depending on what projects are chosen, the national programme in 1971 could be either twice or two-and-a-half times the contribution to Europe. The latest satellite—to be called Azur once it has achieved orbit—comes under the national programme.



The German satellite Azur.

The seven experiments which Azur contains are aimed at investigations of the Van Allen belts, aurorae and solar particles, and come from the Technical High School, Braunschweig, the Max Planck Institute for Extraterrestrial Physics, Garching, the Max Planck Institute for Aeronomy, Lindau, the University of Kiel and the Institute of Atmospheric Physics, Oberpfaffenhofen. Five of the experiments are to measure protons and electrons at various intensities and from different directions, while the sixth and seventh experiments are a magnetometer, and a photometer for detecting auroral lines. With an apogee of 2,000 miles and a perigee of 240 miles, the satellite should cover a considerable volume of the magnetosphere.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

100 Years Ago

From a leading article, Lectures to Ladies, *in* Nature, *November 11, 1869.*

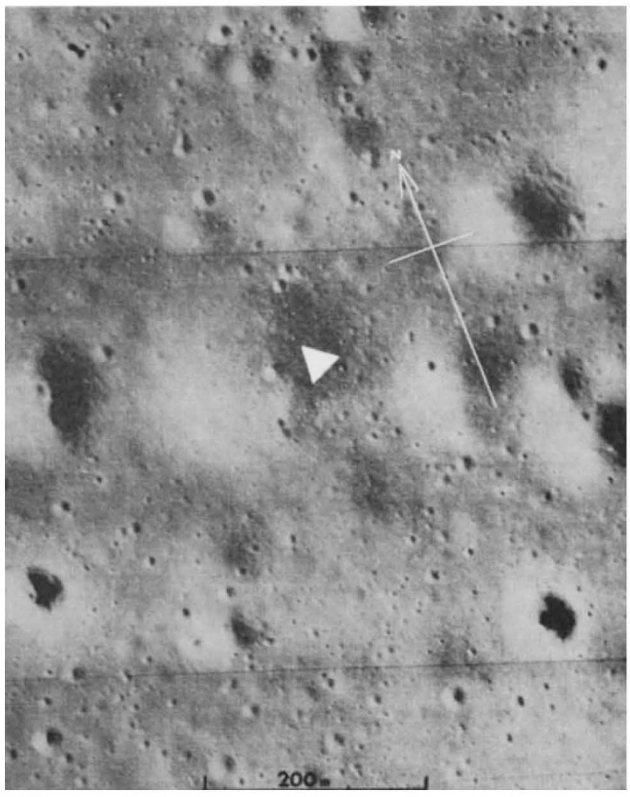
WHAT is the meaning of the present stir about the "Higher Education of Women"? We have before us announcements of courses of lectures intended to be given during the coming winter to the ladies of Edinburgh, London, Glasgow, Manchester and Bradford. . . . If both lecturers and students are in earnest in trying to make these lectures really educational and serious, they cannot fail of producing valuable results. But this will require a good deal of determination on both sides. The most obvious, and perhaps the most serious, danger besetting the teachers, is the temptation—arising from an unconscious want of respect for their audience—to make their lectures *interesting*, instead of trying to impact the greatest possible amount of solid instruction. We confess that one or two very attractive looking programmes that we have seen have suggested the thought, that possibly the lectures they announced might be equally well described as essays, such as constitute the more thoughtful kind of magazine articles; and that, if this were the case, it was not obvious what greater advantage would arise from their author reading them aloud to an assemblage of ladies than would result if the same ladies could be induced to read them aloud to themselves at home. Thorough teaching, and not entertainment, of however high a kind, is what we trust that every lecturer will strive to give, and every student to obtain.

Ladies who intend to join any of the classes now forming will not expect to get any benefit from them, unless they give up for them all other engagements, at least so far as to be able to attend with regularity.

APOLLO

Countdown for Apollo 12

BEING the third and fourth person to land on the Moon does not guarantee a place in the history books, but the crew of Apollo 12 does have the important task of demonstrating that lunar landings are as deceptively easy as Armstrong and Aldrin made it seem four months ago. The countdown for the launch is due to begin today, November 8, and, if all goes well, the crew should be on their way by 1122 EST, November 14. They are Richard Gordon (command module pilot), Charles Conrad (commander) and Alan Bean (who is called the lunar module pilot although it is Conrad who does the flying). Once again a landing site in a flat mare region has been chosen, not far from the lunar equator which is the most accessible part of the Moon.



Close-up of the Surveyor 3 landing site taken by Lunar Orbiter 3. The spot which the crew of Apollo 12 are aiming at is in the top right corner.

Clearly the intention is to practise walking before learning how to run—there will be plenty of time on later journeys to explore more interesting regions such as the large crater Tycho and the Hyginus Rille. Apollo 12 is therefore going to be a case of *déjà vu* as far as the lunar geologists are concerned, although the doubling of the supply of lunar material will be welcome.

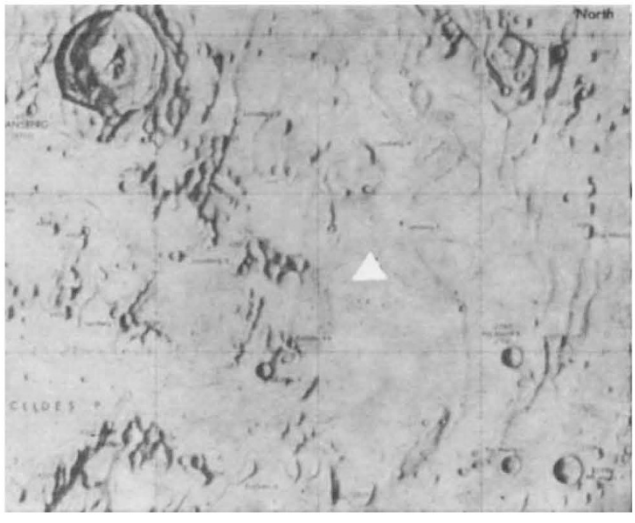
The site which has been chosen is landing site 7 in Oceanus Procellarum—the Ocean of Storms—which as far as anybody can tell is going to be similar to the Sea of Tranquillity. There seems no reason, for example, why the fact that site 7 is in the opposite hemisphere to the Sea of Tranquillity should make any difference. One possibility which people will be watching for, however, is that the surfaces at the two sites may have different ages, and this would have important implications for the history of the Moon.

As before, the mission does not have to be cancelled if for some reason the rocket cannot be launched on November 14. Another launch window opens for three hours on November 16, although this will entail aiming at a different landing site—site 5, which is also in the Ocean of Storms but nearer to the limb of the Moon. Otherwise there are two launch dates in December for the same pair of landing sites.

During the first of the two 3·5 hour moonwalks which are planned, Conrad and Bean will set out a group of five experiments on the surface, which this time includes a seismometer, a magnetometer, a solar wind spectrometer, a suprathermal ion detector to measure positive ions near the surface and a cold cathode ionization gauge to detect lunar atmosphere. The hope is, of course, that the seismometer will check the results from the package left behind in July, which seem to indicate a cold Moon with deep cracks which muffle any shocks which there may be. Another explanation for this seismic silence, apparently not being taken very seriously, is that the weak vibrations were caused by the expansion and contraction of the descent stage, which is still standing in the Sea of Tranquillity. The plan to fire the ascent stage of the Apollo 12 lunar module back onto the surface once it is finished with, primarily to keep the environs of the Moon clear, should help with the interpretation of the seismic records. The intention is to aim it within 30 km of the seismometer. It is a pity that the seismometer in the Sea of Tranquillity is no longer working for comparison.

The advantage which Conrad and Bean have is that their landing site has already been examined at close quarters by Surveyor 3 which landed there in April 1967. During their second moonwalk, Conrad and Bean are to descend into the 200 m diameter crater where Surveyor landed to see how it has fared during its two-year stay on the Moon. Conrad will cut away several parts of the spacecraft, including the television camera and a length of cable. The bacterial load on the cable at launch was well known, and the intention is to see what effect the lunar environment has had. The problem is of course to land within comfortable walking distance of the Surveyor, and, going by the experience of Armstrong and Aldrin, this is not going to be easy.

Oddly enough, an accurate landing is not likely to be quite as important for some of the later missions, even though visits to precisely defined sites on the Moon are planned. This is because the Boeing company is developing a roving vehicle, which ought to be ready for use on Apollo 17 in November 1971 and on succeeding missions. The $19 million contract to Boeing which was announced last week will provide four of these 400 lb vehicles—which, with the driver and passenger seated side-by-side will have an odd resemblance to a vintage car—and each will be flown to the Moon in the lower stage of a lunar module. It sounds like the answer to the city driver's dreams. Each of the four wheels is powered by a separate electric motor, and these are coordinated so that the rear wheels follow the same



Location of Apollo 12 landing site in the Ocean of Storms. The lunar equator is along the top. Crater Lansberg, 25 miles across, is in the top left corner, and the squares have a side of two degrees.

track as the front wheels in a turn. As well as allowing a tight turning circle, this arrangement reduces the power required for steering over the Moon's dusty surface. With a cruising speed of 9·2 miles per hour—on a smooth surface—and a range of 66 miles it looks as if the full use of the vehicle will depend on a substantial increase in the length of time an astronaut can rely on his life-support system.

Precision of landing on the Moon's surface boils down to the need for an accurate knowledge of the position of the lunar module when the descent to the surface begins. The crew will no doubt take pains to avoid disturbing their orbit prior to this stage of the mission. The dumping of water, which is thought to have contributed to the large error last time, is going to be avoided for eight hours or so before the landing. Separation of the lunar module from the command module will be done as gently as possible and with the axis of the combined spacecraft aligned along a lunar radius vector. This should avoid any unknown perturbations in the velocity of the lunar module in the direction in which it is travelling. And the pirouette by the lunar module so that the pilot of the command module can make sure everything looks all right will be shorter than last time; small changes in the orbit of the lunar module are believed to have crept in at this stage of the Apollo 11 mission contributing to the error at the landing site.

If all this works, Conrad and Bean will touch down on November 19 within about 1,120 feet of Surveyor 3 at latitude −2·98°, longitude −23·39°. If necessary, however, this could be up to 3,300 feet from the lunar module. It is during the second moonwalk that the samples will be collected, and the same methods will be used as in July. About 130 lb of material is to be collected, compared with the 48 lb brought back by Apollo 11, and will include core samples down to 10 inches beneath the surface and material from a 6-inch deep trench which the astronauts will scoop out.

FLUID POWER

Boost for Hydrostatics

THE importance of strengthening research on fluid power was the message of Dr Ernest Davies, the recently appointed Joint Parliamentary Secretary at the Ministry of Technology, when he opened the new Bramah fluid power laboratory at the National Engineering Laboratory at East Kilbride last week. He was optimistic about the hydrostatically controlled car. "One of the most exciting prospects for the future," he said, "is a car with a single pedal control, the drive going through hydrostatic transmission in place of the conventional clutch, gear box and differential. The National Engineering Laboratory is now working side by side with British Leyland to see how these ideas can best be exploited commercially."

Hydrostatic transmission systems differ from hydraulic systems in that the power is transmitted as internal or potential energy within the fluid rather than as kinetic energy. This has several advantages. For one thing, it is possible to have outlets that can operate either by suction or ejection, which makes it possible to combine the action of a motor and a brake in a single system. The laboratory has found the hydrostatic transmission system useful for producing high torque at low speeds. Two successful applications have been in contractors' dumper trucks and for the drive of a 50 foot radar aerial weighing about 10 tons.

The Bramah building is destined to be a focus of research in both the pure and applied sides of fluid power. Built at a cost of £400,000, it will house projects to study hydrostatic pumps, motors and other components of fluid systems and to follow through the applications to machine tools, motor vehicles, ships and a variety of industrial equipment. The outlook for machine tools operating with hydrostatic transmissions is thought to be particularly bright, especially for the new type of lathe in which the work-piece is used as the tool.

One of the chief factors preventing the more widespread introduction of fluid power systems is believed to be some lack of confidence in replacing proven mechanical systems by devices whose value has been proved only on paper. This seems to be particularly true in the motor industry, although the collaboration between NEL and British Leyland offers a way out of the vicious circle. The NEL also has high hopes of marine uses for its motors with radial pistons, whose efficiency at low speeds offers a realistic alternative for the tug.

At present, fluid power research takes up about 12 per cent of the budget of the NEL, which has an annual expenditure of about £2·25 million.

WHITE FISHERIES

More Money for Fish

THE White Fish Authority in its latest research and development report has once again emphasized the fact that it wants very much more money for this work for which it currently has little more than £400,000 to spend each year. Half of this sum comes from its own funds and half from the Treasury via the Ministry of Agriculture. Even to outsiders, this sum seems too small for the range of development work the authority wants to do for the fishing industry. This includes such wide ranging activities as research on the mechanization of fishing operations and fishing aids, the handling, processing and distribution of fish and the practicalities of marine fish farming (see *Nature*, **224**, 205; 1969). The authority finds it difficult to cope with many individual projects needing annual budgets of more than £20,000.

It has nonetheless made some significant progress recently with such things as boxing and transferring catches at sea, and the development of a gutting machine.

While such developments will, of course, help the economics of the industry and the safety of the crews, the authority's other objective is more satisfied customers. To improve the image of fresh and frozen fish among housewives, the authority has been experimenting with sales of prepackaged chilled wet fish in supermarkets and with new fish products such as canned soups, fish potato chips, and fish crisps. In particular the authority has been directing its efforts at schoolchildren in the past two years. The problem is that the Department of Education and Science recommends that children should be served only two fish meals out of twenty in school. If four meals a month became the recommended level, the authority claims that the British fishing industry could benefit by another £2 million a year. But would schoolchildren