CONTINENTAL AFFAIRS

by Our Continental Editor

Report on First Manned Space Flight

The following article is a condensed version of a report which appeared recently in the Soviet press concerning the first manned space flight.

On April 12, 1961, the Soviet spaceship "Vostok" ("East"), with Major Yury Alexeyevich Gagarin on board, was put into orbit, thus effecting the first manned space flight in history. The satellite spaceship weighed 4725 kg, not counting the final stage of the carrier rocket.

According to clarified data obtained by processing all the measurements, the perigee of the orbit was 181km and the apogee 327km, while the inclination of the orbit itself was 64 deg. 57 min.

After its orbital flight the satellite spaceship landed safely in a predetermined area of the Soviet Union. The flight was preceded by a number of control launchings of the "Vostok," the last two in March, 1961. During these launchings a dummy was put in the pilot's seat. In addition the cabin contained test animals (the dogs "Chernushka" and "Zvyozdochka"). The flights were effected successfully and in accordance with the programme designed for the ship's first flight with a man aboard.

The satellite spaceship consists of two main compartments:

The pilot's capsule, with its accommodation for the pilot, the life-sustaining installations and the landing system;

The instrument section with the instruments working during the orbital flight, and the vessel's retro-engines.

After orbiting, the spaceship separates from the last stage of the carrier rocket. In flight its instruments work according to a special programme which ensures taking orbital measurements, transmitting to earth telemetric information and the televised image of the pilot, two-way radio communication with the earth, maintenance of the required temperature in the ship, and air-conditioning in the pilot's cabin. The instruments are controlled automatically by means of programming devices in the space vehicle or, if necessary, by the space pilot himself.

The programme of the first manned flight was devised for one revolution round the earth. However, the design and equipment of the space vehicle allows for longer flights.

When the flight programme is completed, a special system orientates the vehicle in space for descent. Then, at a specific point in the orbit, the retro-engine is switched on, which reduces the vehicle's velocity to the calculated value. As a result, the vehicle enters into its descent trajectory.

The capsule with the space pilot is decelerated in the atmosphere. The re-entry trajectory is chosen so that the deceleration load on entering the dense layers of the atmosphere will be no greater than the loads permissible for man. When the capsule reaches a specified altitude, the landing system is switched on. The actual landing of the capsule takes place at a low speed. The vehicle travels some 8000km from the moment the retro-engine is switched on till the moment it touches the ground. This stage lasts approximately thirty minutes.

The shell of the pilot's capsule is covered with a heat shield which protects it from burning up during its flight through the dense layers of the atmosphere. The shell has three portholes and two rapid-action hatches. The portholes are provided with heat-resistant glass, making it possible for the pilot to conduct observations throughout the entire flight.

The space pilot occupies an ejector seat, in which he remains during the whole of the flight and which enables him to leave the vehicle should the need arise. The seat is so installed that the load during the orbiting and re-entry stages acts on the pilot in the most favourable direction (chest-back).

In the first flight the pilot wore a protective space suit safeguarding his life and ensuring his working ability even if the hermetic sealing of the cabin broke down in flight.

The satellite spaceship also carried the following systems:

Instruments and equipment necessary for the vital functions of the human body (an air-conditioning system, a pressure control system, food and water, a system for removing the body's waste products); flight control equipment and a system of manual control of the vehicle (the pilot's panel, an instrument board, a manual control system, &c.); a landing system; radio apparatus for communications with the earth; an autonomous system recording the work of the instruments, the radio telemetric systems and various sensors; a television system for observing the pilot from the earth; instruments for recording the physiological functions of the body; the retro-engine of the vehicle; an orientation system; a flight control system; radio systems for orbital measurements; a temperature control system; and electricity supply sources.

On the outside surface of the vehicle are mounted the control units, orientation elements, shutters of the temperature control system, and the aerials of the radio systems.

The pilot's cabin is much roomier than the pilot's cabin in an aircraft. The instrumentation of the cabin is designed so as to ensure the greatest convenience for the pilot in flight. From his seat the space pilot can perform all the necessary operations connected with observation, communication with the earth, and control the vehicle without leaving his seat.

The frame of the pilot's seat carries: a detachable back with a safety belt to hold the pilot in position when catapulting and parachuting; parachute systems; catapulting and pyrotechnical devices; an emergency store of food, water, and equipment and means of radio communication and direction finding for the space pilot to use after landing; a space suit ventilation system and a parachute oxygen supply unit; a system for automatic operation of the seat.

The space pilot can land in the cabin of the vehicle. This method of landing was tested in the fourth and fifth Soviet satellite spaceships with animals. A variant is also provided for in which the pilot is catapulted with the seat from the cabin at an altitude of some 7km and is landed by parachute. This was also tested in orbital spaceship launchings.

The air-conditioning system in the space vehicle maintains normal pressure and normal oxygen content, a carbon dioxide content of not more than 1 per cent, a temperature of 15 deg. to 22 deg. Cent. and a relative humidity of 30 to 70 per cent. Regeneration of the air—absorption of carbon dioxide and water vapour and injection of the necessary quantity of oxygen—is effected by means of highly active chemical compounds. The regeneration process is automatically controlled according to the amount of oxygen and the concentration of carbon dioxide and humidity.

The temperature control system uses a constant temperature liquid cooling agent to transfer the heat from the pilot's cabin to a liquid-gas radiator. The flow of air through the radiator is regulated automatically, depending on the temperature in the descending vehicle.

To keep the temperature of the cooling agent at the required level and to ensure the necessary temperature in the instrument section, an automatic radiation heat exchanger with a system of shutters is placed on the outside surface.

For landing in a designated area the vehicle must be carefully orientated in space and stabilised before the retro-engine is fired. In the present flight one of the axes of the vehicle was orientated in relation to the sun. A series of optical and gyroscopic sensors send signals to an electronic pack where they are transformed into commands governing the control systems.

When the vehicle has been orientated the retro-engine is fired at a specified moment. The commands for switching on the orientation system, the retro-engine and other systems are issued by an electronic programming device.

The spaceship carries radiometric and radio-telemetric equipment for orbital measurements and for controlling the work of the instrumentation. Trajectory measurements and the reception of telemetric information during the flight are carried out by ground stations in the Soviet Union. The data are relayed along communication lines to computing centres where they are processed by electronic computers. As a result, orbital information is constantly available throughout the flight and it is possible to forecast the further movement of the ship.

The vehicle also carries a "signal" radio system working on a frequency of 19·995 Mc/s

A television system transmits to the earth images of the pilot and makes it possible to carry out visual observations of his condition. One television camera transmits a full-face view and the other a side-view of the pilot.

Two-way communication with the earth is ensured by a radio-telephone system working on short waves (9·019 and 20·006 Mc/s) and ultra-short waves (143·625 Mc/s).

The FM channel is used for contact with ground stations from a distance of 1500 km to 2000km. Communications in the short-wave channel with ground stations located in the Soviet Union can, as the experiment has shown, be carried out from the greater part of the orbit.

The radio-telephone system includes a tape recorder for recording the pilot's speech in flight and subsequent reproductions and transmission when the vehicle passes over the ground receiving centres. The space pilot is also provided with a key for telegraphic communication.

The instrument panel and pilot's dashboard in the cabin are designed for controlling the work of the main systems and ensuring, if necessary, a manually controlled descent of the vehicle. The instrument panel carries a number of dials, light signals, an electric clock, and a globe which revolves synchronically with the vehicle's motion in orbit. The globe enables the pilot to determine his position in flight. The pilot's dashboard carries levers and switches for operating the radio-telephone system and regulating the temperature in the cabin, and also for switching on the manual controls and retro-engine.

Although in designing the spaceship special attention was paid to ensure reliable working of their apparatus and equipment, nevertheless, in the "Vostok" a number of additional measures were taken to preclude the possibility of any accidents and to guarantee the safety of a manned flight.

In order to orientate the ship when steered manually the cosmonaut uses an optical device to determine the position of the ship in relation to the earth. This device is installed in one of the portholes of the cabin, and consists of two annular mirrors, a light filter and a graticule glass. The rays travelling from the line of the horizon strike the first reflector and, passing through the glass of the porthole, reach the second reflector, which directs them through the graticule to the eyes of the pilot. If the ship's bearings in relation to the vertical axis are correct, the pilot sees the horizon in the form of a circle in his field of vision.

Through the central part of the porthole he sees the part of the earth's surface directly below him. The position of the ship's longitudinal axis in relation to the direction of flight is determined by watching the "run" of the earth's surface in the field of vision.

The pilot's field of vision can be covered by the light filter or shutter if necessary.

A globe installed on the instrument panel makes it possible, in addition to ascertaining the ship's bearings during the flight, to predetermine the landing place if the braking device is switched on at any moment during the flight. Finally, even if the braking device should fail the design of the ship allows for landing with the help of the natural frictional action of the atmosphere.

The supplies of food, water and regeneration substances and the capacity of the electric energy sources are calculated for a flight of up to ten days.

Medical-Biological Problems

In solving the problem of the possibility of a manned space flight and its medical safety, it was found necessary to study the influence of space flight on the organism, as well as possible ways and means of protection; to work out the most effective methods of ensuring normal living conditions in the cabin; and to develop methods of medical selection and training of the members of the crew of spaceships, and also a system of uninterrupted medical control of the pilots' health and capacities throughout the flight.

Each of these questions entailed a large number of particular problems, on the study and solution of which specialists in the fields of physiology, hygiene, psychology, biology and clinical and professional medicine worked uninterruptedly in the course of ten years. Research was carried out in laboratories on earth and during the flights of animals in rockets. The influence of various strains and the organism's reaction to them were studied in centrifugal machines which reproduced accelerations analogous to those occurring during the periods of boosting and recovery.

With the help of vibro-stands, thermo- and vacuum-chambers and similar units, the action of other factors on the organism was studied. However, the laboratory experiments, as a rule, could furnish answers only with regard to the action of any particular one of these factors on the organism, whereas during a real flight in a rocket these factors act simultaneously and in combination. Besides, the behaviour of living organisms in the condition of weightlessness could not be studied in the laboratory. Considerable importance therefore attached to the animal experiments using rockets which began in 1951 in which conditions of true space flight were approximated.

Several dozen experiments were made on dogs, rabbits, rats and mice which ascended to altitudes of up to 450km. Examination of the test animals, both during the flight and during a prolonged period after their return to earth, made it possible to draw the conclusion that living organisms withstand the conditions of flights in rockets to the upper layers of the atmosphere quite satisfactorily. The changes observed in some of the physiological functions during the flight were not of a pathological nature; quite often they disappeared while the experiment was still in progress and did not reappear subsequently.

However, owing to the short duration of rocket flights there was no possibility of studying the biological effects of such important factors of space flight as prolonged weightlessness and cosmic radiation. Therefore, the opportunity of using artificial earth satellites for biological experiments which became possible in 1957 was an exceptionally important step forward.

The first such experiment was conducted on the second Soviet sputnik. It not only confirmed but augmented the data on previous biological experiments on rockets. It was proved for the first time that a prolonged state of weightlessness, as such, does not violate the basic vital processes.

Biological experiments were continued in the first Soviet orbital spaceships. This programme included an additional and more thorough study of the influence of prolonged weightlessness on the organism, as well as of the transitional condition from weightlessness to overstrain and vice versa. A thorough research into the biological effects of cosmic radiation was also undertaken.

An important part of the programme was the study of the peculiarities of the operation and effectiveness of systems which in future flights should ensure normal conditions for man's vital activity and guarantee his safe return to earth. In carrying out the planned programme, diverse representative specimens of the organic world, from the simplest forms of life up to higher vertebrates, were placed in the first Soviet orbital spaceships.

The utilisation of various species of animals and plants for experiments made it possible to study very thoroughly and in great detail the influence of the conditions of space flight on the most diverse processes and functions of organisms. Data on the behaviour and physiological functions of experimental dogs during flight were particularly plentiful. The behaviour of animals was observed with a special television system. An analysis of the data obtained showed that the animals not only fully retained their vital activity under conditions of the protracted effect of weightlessness and the following influence of overstrain, but that no morbid symptoms were discovered in the condition of their main physiological functions. A sufficiently prolonged and careful investigation of the animals after flight also did not reveal any deviation whatsoever from the normal.

Particularly serious attention was devoted to detecting any possible effects of cosmic radiation during the flight of an orbital spaceship. The numerous methods used for solving this problem did not reveal changes which could possibly have been caused by ionising radiation.

The results of the medical-biological research conducted in orbital spaceships made it possible to conclude that flights in such ships, admittedly circling lower than the radiation belts around the earth, are safe for highly organised representatives of the animal kingdom.

In recruiting the group of cosmonauts, there were talks with a great number of pilots who had expressed the wish to make a space flight. Those of them who were considered most suitable were subjected to a careful clinical and phychological examination, including investigations in the pressure chamber at considerable degrees of rarefication of the air, during abrupt changes in the barometric pressure and the breathing of oxygen at increased pressure, investigations in the centrifuge, &c. This was followed by tests designed to seek out persons possessing an especially retentive memory, resourcefulness, keen attention that can easily be switched from one thing to another, and the ability to make precise co-ordinated movements speedily. Those selected underwent a programme of instruction designed to supply information on basic theoretical questions as well as practical skill in the use of the equipment and instrumentation of the spaceship's cabin. This programme provided for the study of the fundamentals of rocket and space techniques, the design of spaceships, and special problems of astronomy, geophysics and space medicine. Training included: flights in planes in zero-gravity conditions; training in a replica of the spaceship cabin and on a special training device; prolonged spells in a specially equipped sound-proof chamber; training in the centrifuge; and parachute jumps from planes.

This work also helped to solve certain problems of manned space flight, in particular those connected with the feeding of the cosmonaut in flight, his space suit and the system of air regeneration.

During the flights in planes individual reactions during weightlessness and transition from weightlessness to overstrain were studied. The possibility was studied of maintaining radio communication, taking water and food, &c.

It was found that all those who had been selected endured zero-gravity well. Besides, it was established that in a state of weightlessness lasting for up to forty seconds they could normally take liquids, semi-liquids and solid food, perform intricate co-ordinated acts (writing, purposeful movements of the hands), maintain radio communication, read and orient themselves visually in space.

Training in the replica of the spaceship's cabin and in the special training device was designed to enable the cosmonauts to study the equipment and instrumentation of the cabin, practise the versions of the flight task and accustom themselves to being in the cabin of the actual spaceship. For this purpose a special training stand was designed with electronic devices with the changes taking place during the real flight being simulated on the instruments. The pilot acted just as he would in space. An opportunity was provided of simulating unusual (emergency) versions of the flight and training the cosmonaut to act in such circumstances.

The main task of the investigations conducted during prolonged stay in the specially equipped sound-proof chamber was to establish the nervous-psychological stability of the cosmonaut during a prolonged spell alone in the isolated, closely confined cabin, with a considerable reduction of external irritants. In the course of this training the routine and feeding processes of a real flight were simulated.

On the basis of tests on the centrifugal machine and in the thermal chamber the influence of these effects on the basic physiological functions was studied, and individuals were singled out who stood the tests better than others.

During the course of air-drop training each cosmonaut had to make several dozen jumps. Physical training consisted of planned sessions based on the individual cosmonaut's physique, and setting-up exercises, conducted for an hour daily. The latter combined selected exercises, games, diving, swimming and excercises on special apparatus.

Direct preparations for the forthcoming space flight were organised when the special training programme had been concluded. These comprised aspects of piloting and navigation, the use of the emergency pack, training on a centrifugal machine in a space suit with the maximum load that may be expected; prolonged training in a model spaceship with the use of all the life-saving systems, &c.

A group of the best men ready for space flight were picked from among the trainees.

First Space Flight

The "Vostok" took off at 9.07 a.m. (Moscow time) on April 12. During the entire boost stage Gagarin maintained constant communication by radio-telephone with the flight centre on earth; the cosmonaut felt very well on this section of the flight. He recorded precisely the changes in load and the stages of separation of the carrier rocket. The noise in the ship's cabin did not exceed the noise in the cockpit of a jet plane. Gagarin watched the earth through the portholes even during the boost stage.

The equipment during the orbital flight, orientation and landing of the ship were effected automatically. However, in case of need, the cosmonaut, at his own discretion or at a command from the earth, could have taken over the control of the ship, determined his location and made the landing in the selected area.

After the spaceship was put in orbit a state of weightlessness set in. At first this condition was strange for the space pilot, but he soon accustomed himself to it. Gagarin felt fine throughout the entire period of weightlessness and retained full command of his faculties.

In conformity with the flight programme he kept watch over the functioning of the spaceship's equipment, maintained without interruption

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communication with the earth by radio-telephone and telegraph, conducted observations through the portholes and the optical orientation device, sent reports to earth, recorded observation data in his logbook and on magnetic tape and took food and water.

The surface of the earth was clearly visible from up to 300km. Coastal lines, big rivers, terrestrial relief, forests and clouds and the shadows from them were observed very well. In a pitch black sky, the stars looked brighter and clearer against it than from the earth. The earth had a very beautiful pale blue halo. On the horizon the colours changed from a delicate light blue through ultramarine, dark blue and violet, and finally to black sky. When emerging from the shadow, a vivid orange flash, which then passed through all the colours of the rainbow, could be observed on the horizon.

At 9.51 a.m., approaching Cape Horn, the spaceship's automatic orientation system was switched on and, after the ship emerged from the shadow, it orientated the ship on the sun.

At 10.15 a.m. the automatic programming control device commanded the equipment in the ship to prepare for the firing of the retro-rocket. At that moment the ship was over the approaches to Africa.

At 10.25 the retro-rocket was fired and the spaceship veered off the orbit of an earth satellite on to its descent trajectory.

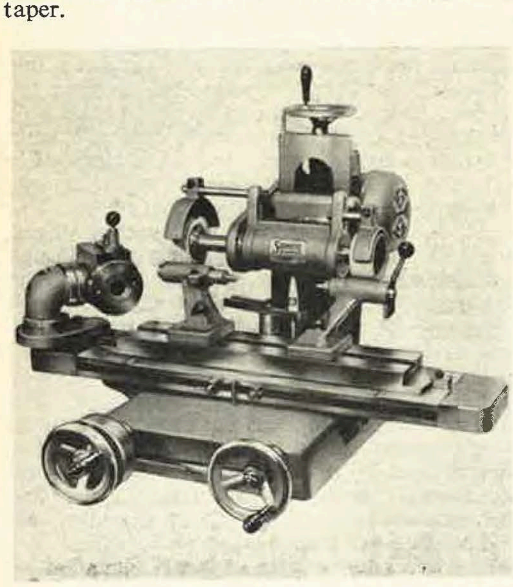
At 10.35 a.m. the ship entered the dense layers of the atmosphere, and at 10.55 a.m. it landed in the designated area.

Since his return Gagarin has felt well and no disorders in his bodily health have been revealed.

Tool and Cutter Grinder

A universal tool and cutter grinder made by Schütt, of Trollbacken, Stockholm, is now available through Associated European Sales (Great Britain), Ltd., 6, Bloomsbury Square, London, W.C.1. As may be seen from our illustration, the machine consists principally of a base, table, wheel head, and work head. With additional equipment it can grind external and internal diameters as well as flat surfaces and sharpen twist drills. The table measures 18¼in by 3¼in, runs on roller bearings and is laterally guided by ball bearings in a manner designed to eliminate play. For taper grinding the table can be swivelled through 10 deg. on either side of the central position. The wheel head can be swivelled horizontally through 360 deg. and vertically through ± 15 deg. The grinding spindle (spindle speed 4900 r.p.m.) has automatic compensation for axial and radial play.

The work head can be swivelled through a full circle both horizontally and vertically, setting being aided by fully graduated scales. The dividing plate has twenty and twenty-four holes. The work spindle is fitted with a No. 4 Morse taper.



Tool and cutter grinder

British Trade Fair in Moscow

Much interest is reported to have already been expressed by the Russians in connection with the forthcoming British Trade Fair in Moscow, during which for seventeen days members of Soviet Foreign Trade Corporations, Regional People's Economic Councils, and factory managers, as well as the public at large, will be able to see for themselves what British industry can offer them. The Fair is stated to be the biggest foreign exhibition ever to be held in the Soviet Union. It is to be followed by a Soviet Exhibition at Earls Court, London, in July.

NEXT week, on May 19, a British Trade Fair, is due to open in Moscow at the Sokolniki Park of Culture and Rest. The fair which is to stay open until June 4 is being held under the joint sponsorship of the Association of British Chambers of Commerce and the All-Union Chamber of Commerce of the U.S.S.R. It will be followed by a Soviet Trade and Industrial Exhibition to be held at Earls Court, London, from July 7 to 29, 1961, under the same joint sponsorship. The fair is being organised by Industrial and Trade Fairs, Ltd., with the help of an advisory council of leading industrialists and others with wide experience of trading with the Soviet Union. Though the Board of Trade is taking part in the fair as an exhibitor, the fair, which it is estimated will cost £2,000,000, is being financed entirely by the participants and is not being subsidised or underwritten by the Government or by the sponsors.

The object of the fair is to increase British exports to the Soviet Union, or, more specifically, to sell the exhibitors' products. Exhibitors will be displaying products which they believe that the Soviet Foreign Trade Organisations wish to buy, and will not be showing products for which they do not think there will be a market in the Soviet Union. These are the factors which have determined the industrial structure of the fair and which account for the high proportion of capital goods among the exhibits.

Sokolniki Park of Culture and Rest is one of the largest in Moscow. Three foreign exhibitions (American, Czech and Japanese) have already been held there, but the British fair will occupy almost as much covered area as all its predecessors put together. The British Trade Fair will in fact be by far the biggest foreign fair ever held anywhere in the Soviet Union. Fig. 1 shows the layout of the fair which occupies an area of about 23 acres or over 1,000,000 square feet. The shape of the site is approximately that of an isosceles triangle with two sides of 600 yards and a third side of 375 yards.

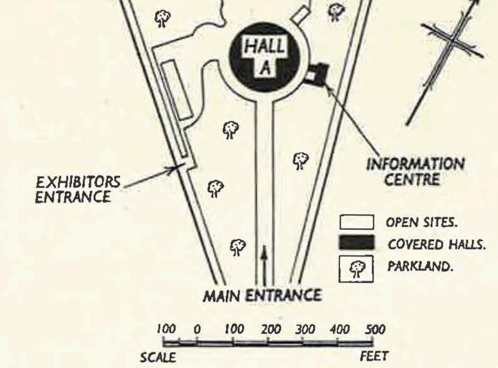


Fig. 1—Exhibition grounds in Sokolniki Park

There are four exhibition halls: Hall "A," a geodesic dome in aluminium with a gross area of 26,000 square feet; Hall "B," a fan-shaped building constructed largely in steel and glass with a gross area of 49,000 square feet; Hall "C," a square building in concrete and glass of 21,000 square feet, connected to the gallery of Hall "D," with an escalator to carry visitors across the road which runs between Halls "C" and "D"; and Hall "D," a rectangular building in concrete and glass on two floors. The building is 550ft long and 180ft wide, offering 102,000 square feet of space on the ground floor and 30,000 square feet on the gallery.

The total gross covered area will therefore be 228,000 square feet.

In addition, a number of exhibitors are displaying their products in the open air on sites marked on the exhibition site plan.

Halls "A" and "B" were constructed for the United States National Exhibition held in the summer of 1959 and subsequently sold to the Russians for approximately 50 per cent of their original cost. Halls "C" and "D" have been newly constructed by the Moscow City Soviet for the British Trade Fair and for the French National Exhibition which will follow later this year.

Under an agreement signed last May, of the cost of Halls "C" and "D" amounting to approximately £500,000 sterling, the British organisers and the General Commissariat of the French National Exhibition will bear one-quarter each, the rest being met by the Moscow City Soviet whose property the buildings will eventually become. The two halls were designed by architects of the Institute Mospoekt, Moscow, under the direction of Messrs. Wilensky and Vinogradsky in co-operation with Jack Howe and Partners, architects for the British Trade Fair, and Monsieur M. L. Gauthier, architect to the French National Exhibition.

A total of 621 companies are taking part. The breakdown of exhibitors by industries gives the following picture (some participants being represented in more than one category): Plant and Machinery, 181 (including machine tools, sheet-metal-working machinery, plastics machinery, food processing plant, textile machinery, refrigeration, dairy and bottling plant, materials handling equipment, mining machinery and laundry plant); Electrical Engineering, 48 (including electronics and radar, radio and television); Scientific Instruments, including instrumentation, over forty-one; Materials, including iron and steel, wood, plastics, rubber and glass, sixty-six; Chemicals and Pharmaceuticals, thirty-two; Engineering Components, including gears, belting, hose, couplings, clutch and brake linings, forty-five; Vehicles, including passenger cars, commercial vehicles, rolling stock, locomotives and ships, seventeen; Medical, Dental and Veterinary Equipment, eight; Textiles and Clothing, 140; Leather and Footwear, 112; Books, Musical Instruments, Toys and Games, fifteen; Household Goods, twenty-two; Office Machinery, seven; Banks, airlines and Government Departments, twelve.

In Hall "A," among many other exhibits,