THE ITALIAN NATIONAL SCIENCE MUSEUM AT MILAN

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THE museums of Italy are at a most lively stage of development. During the War they suffered heavy damage; but rebuilding has proceeded at a pace that makes progress in Britain seem very inadequate by comparison. The result of rebuilding, re-design and re-organization has been a sharp rise in attendances from 800,000 in 1946 to 4,725,000 in 1952 at national museums. This figure is nearly double the highest pre-war number of visitors in a year (1937) and applies, naturally, to art museums in the main. There is, however, one striking example of the way science has shared and is to share in these developments.

The National Museum of Science and Technology at Milan is housed in buildings which follow the plan of the badly war-damaged early sixteenth-century Monastery of San Vittore. Leonardo's "Last Supper" was painted a few years earlier only a short distance away and he was still working in Milan when the Monastery was built. The man who, above all others, combined mastery in sciences with mastery in the arts is therefore specially honoured in this new Museum. The display of models to celebrate the fifth centenary of the birth of Leonardo da Vinci has already been described and most of the models are replicas of those built in Italy, exhibited there in 1939, taken to New York in 1940, and destroyed by fire in Tokyo during the War. It will therefore suffice to say that these models are built with a genuine feeling for the methods and materials of the time, are very well set out, and are to such well-chosen sizes that the aeronautical items, for example, really do look as though they might take to the air without breaking up. Leonardo's sketches were not dimensioned, so that interpretation becomes most important when building models to his ideas. In a few cases, such as excavators and cranes, Leonardo's original suggestions are shown in model form with models beside them to show the not so very dissimilar (making allowances for a five-century interval) modern counterparts.

So far the Museum is in a very early stage of development, although representatives at the third International Conference on Museums held in Milan this year were greatly impressed with what had been done, so quickly, under the guidance of Dr. Guido Ucelli. The Leonardo exhibits predominate, with another important gallery displaying an attractive collection of models of warships, merchantmen and small craft as the Italian Naval Museum. A start has been made on a section to illustrate the history of aeronautics; but this can scarcely be more than a token until a new arch-roofed building, the frame and most of the walls of which are now to be seen, is completed. Here the aeronautical collections of the Italian Army, at present stored in Rome, are to be set out by Captain Soldatini, who has already been responsible for the instruments of warfare in the Leonardo Collections.

Extensions are also being built at the present time to include a cinema for scientific films and a library of the history of science, to which Dr. Ucelli will contribute his own extensive collection of books. There already exists a reading room in which many technical periodicals are regularly received.

At the present time about two thousand visitors go to this new Museum every week; but it is to be expected that much greater numbers will attend as the collections develop. The support of industry has still to be obtained before many projected new sections can be planned on an adequate scale. There is little doubt that this will be forthcoming eventually, and in that respect the wisdom of actually opening the Museum to the public is incontestable. Ships, aeroplanes and Leonardo da Vinci happened to be the three subjects on which sufficient material or impetus existed. For future developments much will depend upon which industries react most favourably to the suggestion that they should contribute both in material and in finance for display. The fact that there are now an embryo but effective Museum and already an interested public should be of the greatest assistance in influencing such potential benefactors.

The Museum buildings themselves are worthy of comment. The damage to the sixteenth-century Monastery (itself on the site of an older monastery, which in turn occupied a site on which there can still be seen remains of a Roman wall) was of so fundamental an order that the present buildings may practically be described as new. Such skilful use has been made of new materials that the monastic atmosphere remains; and yet an impression of modernity is conveyed at the same time. The Leonardo Gallery on the first floor has a high arched roof and looks, from its length, not unlike a cloister in some respects. Yet the display of Leonardo models is modern and attractive. Each model is on a table made by bending and toughening a long

Fig. 1. View of the large conference hall where the display from the International Conference on Museums is arranged

Fig. 2. View of the first cloister. Foreground : remains of ancient Roman walls

rectangular sheet of plate glass. A concealed fluorescent lamp lights each model and the only daylight comes from a few small circular windows up near the ceiling. The finish of walls and ceiling is of whitewash. The result is a well-graded illumination and no violent contrasts to disquiet the eye such as the transition from, say, 10 candles/sq. ft. on an exhibit to a brightness of 2,000 candles/sq. ft. or more from the sky seen through a window as soon as the eye is lifted. Unrestful contrasts of this order are common in most museums, and it is very pleasant to go around galleries such as these in Milan where violent brightness transitions are avoided.

This Science Museum in the making is worthy of great support, and its development should be very interesting to watch. In connexion with the International Conference on Museums a series of more than a hundred panels of photographs were contributed by more than twenty museums of science and technology throughout the world to illustrate their techniques and achievements. These are displayed around the principal lecture theatre in the Museum, and Dr. Ucelli hopes to retain them for some time to help him to show what other countries are doing and to obtain further interest in his own plans. In these he will have the best wishes of everybody in the museum world and should attract the support of both science and industry.

SIZE EFFECTS IN THE INITIATION AND GROWTH OF EXPLOSION

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There is a good deal of evidence that the initiation of explosion by impact and by friction is, commonly, thermal in origin[1]. The mechanical energy of the blow or of rubbing is degraded into heat and concentrated to form a small 'hot spot'. These hot spots, though small, are large compared with molecular dimensions. Their size, as we should expect, is very dependent upon the experimental conditions ; but they may range from *c.* 10^{-5} to 10^{-3} cm. in diameter, and their duration[2] may be short, for example, 10^{-5} sec. With many explosions the necessary hot-spot temperature may be *c.* 400° C.–500° C. These hot spots are readily formed in two main ways : (1) by the adiabatic compression of small included gas bubbles ; the presence even of a single tiny bubble can render most explosives extremely sensitive to impact ; (2) by friction on the confining surfaces, on grit particles or on crystals of the explosive itself. Under very extreme conditions, a sufficient rise of temperature can be produced by a viscous heating of the rapidly flowing explosive, but this normally requires a very high impact-energy.

On this thermal mechanism, we should expect that the growth of a small explosion from a hot spot to one of finite dimensions would be governed by simple physical considerations. If the rate of evolution of heat by chemical reaction within the small volume is greater than the rate at which it is lost to the surroundings by conduction and other means, it will grow ; if not, it will die away. The general treatment of this has been given by a number of workers[3]. Calculations for some solid and liquid high explosives[4] show that for a hot-spot temperature of 400°–500° C. the minimum size is in the range 10^{-3} to 10^{-4} cm. diameter. This is in agreement with our measured values.

Irradiation with Electrons and Neutrons

We have recently made some further studies of hot-spot size in initiating explosives by irradiating the explosive crystals with beams of electrons and neutrons, and also by heating very small crystals. It has been suggested[5] that the simultaneous decomposition of two adjacent molecules of lead azide could lead to explosion. Kallmann and Schrankler[6] have observed the initiation of T.N.T., mercury fulminate and azides when bombarded with an intense beam of hydrogen, argon and mercury ions. They have suggested that the explosion is due to the activation of a few neighbouring molecules. Muraour[7] has also observed the explosion of silver acetylide when irradiated with high-speed electrons, and explained the result in a similar way. We find that when crystals of lead azide are irradiated with an electron beam of 75 KeV. and 200 μamp., explosion occurs. It was thought, however, that this and the explosion reported by other workers might be due to a bulk heating of the explosive. The explosive was, therefore, replaced by crystals of potassium nitrate (melting point, 334° C.). These were readily melted in the electron beam, showing that the temperature rise was greater than 334° C. This and additional experiments on the fusion of metallic wires provide strong evidence that the explosion of the azide under these conditions can be due to bulk heating.

In order to avoid this bulk heating, the explosive crystals were bombarded with slow neutrons (flux, 10^8 neutrons per cm.^{2} per sec.). The experiments