THE NATIONAL GALLERY IN WAR-TIME

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IT is one of the necessary sorrows of war that scientific workers are bound, for the most part, to apply their knowledge and skill for the time being to the work of destruction. It is also true, as is already obvious, that some good comes out of evil, but the primary aim is, and must be, to destroy. Naturally, there are heroic efforts to mend and to repair, perhaps even to restore ; yet they are hard pressed to keep pace with the forces of obliteration. In this article, however, we are contemplating a happier theme, in which applied physics and kindred branches of technics have been harnessed deliberately and specifically to a project of conservation. Consideration of some such scheme is usually simplified a little by financial reasoning—the relative value of the things to be kept safe and the cost of doing so. But with the nation's heritage of pictures, in some respects the most precious and representative in the world, these terms become largely meaningless. It is the bare fact of irreplaceability which dominates thought. Loss or serious damage admits of no compensation. If science can help in this great quest for security, it will have shown that even in war its part is not wholly to undo. To save for posterity becomes an overwhelming urge.

Well before the outbreak of hostilities, the Board of Trustees of the National Gallery had approved plans for evacuation from the great building in Trafalgar Square, London. These were, in fact, implemented and the bulk of the collection was hundreds of miles away from London immediately before September 3, 1939. The programme of removal had been accomplished in ten days, in accordance with schedule. A tolerable exile had been arranged in various houses and halls. So far so good. Risks were reasonably spread. Administration and invigilation functioned duly. But was all this sufficient ? Indiscriminate bombing all over Great Britain set in. Nowhere above ground was safe in the special sense applicable to unique and irreplaceable objects. Even the fire-risk assumed new proportions in some respects. Thus, inevitably, the question was raised whether deep shelter could not be found, and if it could, what new hazards and imponderables it would introduce. Here indeed was a task for science, to shoulder its full measure of responsibility. In the sequel, some indication may be seen of the course of events. Meanwhile, all the refuges above ground had fulfilled their purpose, providing safe shelter unimpaired until their supersession.

A Deep Shelter Policy

In a matter of days, as it turned out, the Gallery was committed in principle to seek a subterranean home. The prime need was to find it. Mines, quarries, tunnels, caves, even deep defiles capable of being artificially roofed and reinforced were visited and discussed. Seldom must such a search have been started, and more rarely still could one have been more disappointing in its opening stages. Site after site was rejected on grounds such as those of possible flooding, presence of noxious vapours, insecure roofs, difficult access, probability of becoming a target later on for indirect reasons, and so forth. Up to the time of writing, two of these locations are definitely known to have experienced incidents which, had they happened when in use as repositories, would have constituted in one case a major disaster, and in the other a potential threat too grave to have been disregarded. These facts are mentioned to demonstrate that sanctuary was not to be had merely for the asking.

Six precious weeks went by with nothing to show for them but negation. Then, almost by chance, the outlook changed. A site offering sufficient space to house the whole collection, and possessing between 200 ft. and 300 ft. of rock cover, appeared. The access was not easy, and it was obvious at once that fairly heavy works would be needed to make it suitable for the purpose. Nevertheless, it was possible. The natural temperature within was 47° F. and the relative humidity 95–100 per cent. Tradition locally had it that the temperature was unchanged throughout the year. No data in support of this were extant, and there was no time to begin extended observations. Instruments were put in position for a week as a rough guide. The temperature remained at 47°–48° F. and the relative humidity at a point approaching saturation. There was no alternative but to accept these figures as characteristic. A good record for freedom from falls of roof was produced (for this particular type of workings), and the risk of flooding could be taken as negligible. There were no noxious vapours, and the material present in bulk was chemically inert. There were other features too, not shared by most places of the kind, of a favourable nature. Beyond these broad considerations, nothing could be said with certainty. In addition to the increasing danger to the pictures in their quarters above ground, it became necessary for special reasons to make an immediate decision to accept or reject this place. In any event, some six to twelve months would elapse before it could be ready for occupation.

Within a matter of days, the Trustees, the Treasury and the Office of Works (now the Ministry of Works and Planning) had agreed to accept and to go ahead. It amounted almost to a venture of faith. The National Gallery thus became possessed of a repository offering cover against aerial attack to a degree approaching impregnability. Nothing but an earthquake could harm the contents mechanically. At the same time, due to the high relative humidity, ruin within a month might be expected for the pictures if this was not dealt with, and restrained, during the whole period of occupation. Furthermore, access was physically impossible for a large percentage of the collection. Thus, to begin with, matters were not easy. But the decision was clear-cut. The protective cover was ample, and the capacity for storage adequate. All the other troubles must in consequence be overcome.

Reviewing the situation at the present time, with the great collection safely housed, it may be stated that no major disadvantage was overlooked in that rapid decision. It was thought to be feasible to accomplish the task, and so in the event it has proved. Naturally, this is far from implying that there is little more to do. Life there, in some respects, resembles that of the crew of a ship at sea. Constant watch and ward was never more essential. There is much machinery, and full provision for emergencies. The pictures themselves need thorough-going inspec-

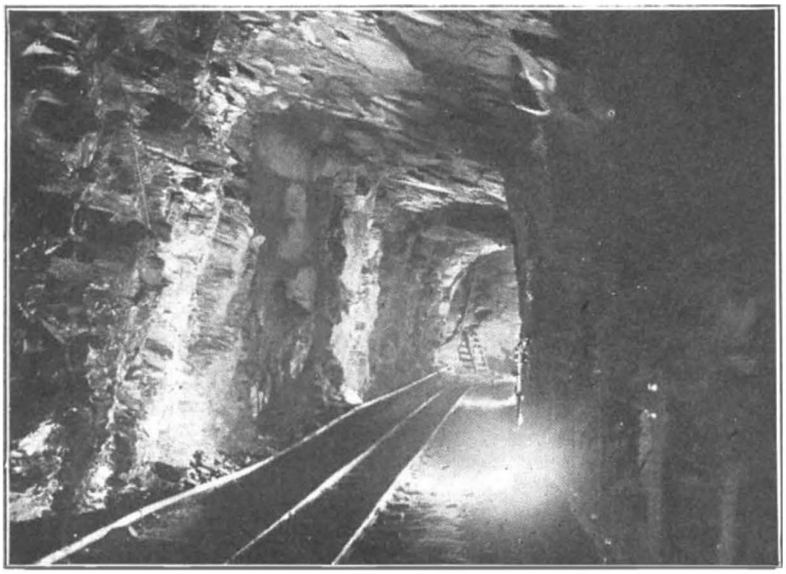

Fig. 1. THE MAIN UNDERGROUND APPROACH LEVEL. THIS WAS ORIGINALLY OF CROSS-SECTION 6 FT. × 6 FT. AND WAS ENLARGED TO 13 FT. 6 IN. HIGH AND 10 FT. WIDE.

tion at frequent intervals, if one is to be reasonably certain that all is well. Sometimes they need treatment, and this has been provided for. Temperatures, relative humidity, ventilation, electrical gear, the stability of the fabric, the workings themselves, all require ceaseless attention if accidents are to be avoided to within the limits of human fallibility. There is plenty of the unknown in this great bid for safety. From the beginning, the main responsibility for the safe-keeping and administration of the National Collection in exile has rested upon Mr. Martin Davies, to whom also is due much of the planning of its underground home.

In the next section, the arrangement of the repository and the apparatus installed will be described in some detail. Where information is lacking, the explanation is probably that data on that particular matter exist, but must be withheld at present for security reasons. When the time is appropriate more can doubtless be said.

The Underground Repository

The decision to place the great national collection below ground having been taken, the work of making the site suitable for the purpose devolved upon the (present) Ministry of Works and Planning. At this point a tribute of appreciation to the officers and staff of that department may be gratefully made, both for what has been done and for the way in which they have striven to meet the special requirements and ideas of the National Gallery. With a project so novel, it was only to be expected that some set-backs would occur; the isolated position and the season of the year in which operations began both had their share in making progress exceptionally difficult and arduous. When the full story of this aspect can be told in detail, it will probably be admitted that the period of preparation, though somewhat longer than anticipated, was not excessive. The managing director of the company working the site did all in his power to help in every way. The site was first seen on September 17, 1940. Four days later the decision to accept it was taken. Blasting operations started a few weeks later, and most of the buildings were ready for drying-out (but not for occupation) in May, 1941. By August, 1941, all essential engineering services had been completed and the buildings were ready to receive the pictures. The move in began on August 12, 1941.

The nature of the underground workings was such that the only reasonable way of securing proper temperature and humidity conditions (as well as due invigilation) was to erect separate buildings underground, and to 'condition' them individually. (By 'condition' is not meant full air-conditioning, as technically understood, but bringing physical conditions within each building to a state satisfactory for the contents, by the comparatively simple means to be described later.)

These buildings were designed to have no mechanical strength; they are simply 'envelopes' on a large scale. Of light brick construction and the inner walls and ceilings covered with wall-board, the floors are concrete, and the roofs are of fabricated material (treated with ruberoid) on top of which rests a wire-mesh mattress. The function of this is to distribute the weight, should any *small* fragments of rock fall from above. No provision is made against *heavy* falls of rock. This matter is one for constant expert vigilance on its own account, and upon it complete reliance

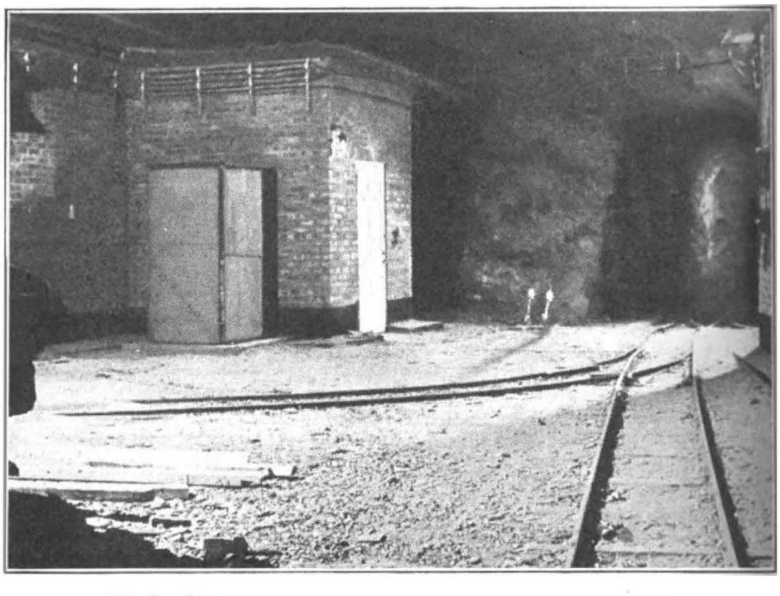

Fig. 2. A TYPICAL PLANT ROOM AND PART OF STORAGE BUILDING.

has always been placed. Steps have been taken to ensure that all aspects of this possible hazard are kept under close review.

A question to be decided at the outset, which had a direct bearing upon lay-out, was the amount of wall-space needed, regarded particularly as a function of height. The guiding principle was that, in general, stacking of pictures was to be avoided. All were to be accessible for ready inspection. In this way, the problem was one of two dimensions rather than of three. The demand for height was such that ten feet would suffice for the great bulk of the collection, with fifteen feet for a small percentage of the total. In fine, this meant six buildings, five giving a headroom of 10 ft. inside, and one with a 15 ft. clearance.

These needs made somewhat rigorous demands upon the placing of the buildings, if maximum accommodation was to be secured. Thus, they vary considerably in shape and size. All except one are on a common level ; the exception is approached by an easy flight of steps, and is reserved for pictures capable of being safely carried up by hand. Fortunately, there are many of a size suitable for this. The question was discussed at the outset whether any real advantage would be gained by having two-story chambers, where the natural height available permitted. This was answered negatively, both on the score of time and expense of making such buildings, and of the difficulty and dangers of taking pictures to and from the upper floor by stairs, lifts or cranes.

It may be mentioned here that the 15-ft. chamber already alluded to was designed to serve a double purpose. Its first duty was to act as the receiving and unpacking station. The vehicles containing the pictures, when they arrived, drove down a tunnel some 200 yd. in length, into this building, which is large enough to allow of turning and is provided with a suitable unloading dock and ramp. In fact, this building was planned in close co-operation with the railway companies who undertook the task of transport. The second purpose of the building was to house the largest pictures, and to act in some measure as an inspection shop for all the larger works. Thus, all unpacking took place in 'conditioned' surroundings. The overall size is solely governed by the amount of space available, but the inside dimensions were most carefully considered in the light of general experience in moving, storing, and inspecting pictures. A fair amount of room is needed for carrying, turning and so forth : to cramp this unduly would be to risk accidents. Almost every building is provided with a small work-room where such operations as laying blisters can be carried out. By these means it is rare that a picture has to leave its conditioned surroundings for treatment.

Fig. 4. INSIDE ONE OF THE STORAGE BUILDINGS, SHOWING PART OF AN AISLE, WITH PICTURES IN POSITION. THE HEIGHT IS 10 FT. FROM FLOOR TO CEILING.

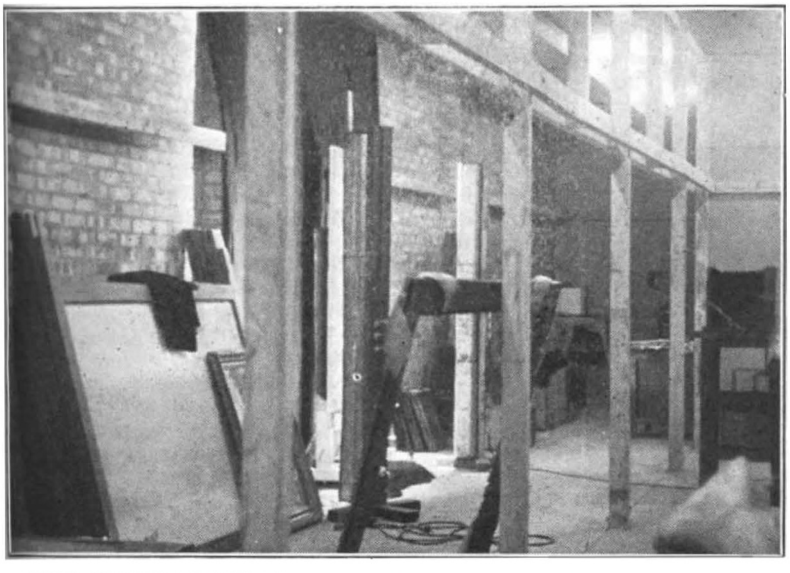

Fig. 3. PART OF A STORAGE CHAMBER BEFORE OCCUPATION, SHOWING STACK OF SCREENS (LEFT), READY TO BE FIXED BETWEEN THE UPRIGHTS IN CENTRE.

The plant-room contains the heating and ventilating machinery required for each building. One such plant-room and equipment suffices for each, except in two instances where shape and capacity necessitated the provision of two such plant-rooms.

The guiding principle in regard to the major problem of 'conditioning'—in the limited sense already explained—has been to make each building a separate self-contained unit which can be controlled individually as desired, so far as temperature and relative humidity are concerned. The advantages of this were found in the early stages of occupation, when the storages were gradually filling up with pictures (after a suitable period of thorough drying-out, expedited by the use of refrigerating plant). Due to the concentration of so much hygroscopic material (wood and canvas), it is easier to obtain stable conditions when a building is full than when it is empty. In addition, certain other categories of valuable material are present, which need a physical environment of a slightly different kind. Again, when material first arrives, it can be gradually acclimatized to its new surroundings by the appropriate regulation of temperature in a certain building.

When the site was first explored, it had three factors of value from the physical and engineering aspects. These were : (1) a constant temperature so low as 47° F. inside the workings, as already mentioned ; (2) easy access to electric power ; (3) water, sufficient for engine cooling. In view of (1), it was considered that a satisfactory relative humidity in the buildings could be obtained by temperature-control alone, that is, there would be no need for a permanent de-humidifying plant. This relative humidity was provisionally fixed at 55–60 per cent at 62° F. It should be maintained constant to within 3 per cent. This is a narrow tolerance. The point is that once a relative humidity between 55 and 60 per cent—say 58 per cent—has been set up within a building fully occupied with pictures, then it is undesirable that fluctuations should lead to higher values than 61 per cent or lower values than 55 per cent. Owing to the impossibility of forecasting exactly what would happen with such an indefinite 'population' as a combination of panels and canvases, it was agreed to proceed on this basis. To anticipate for the moment : experience of a full year's working has shown that the plant gives, as an example, a relative humidity of 57 per cent at 64° F., with a variation in the former of less than 2 per cent over a period of many months. In general, the temperatures in the various buildings are some 2°–3° F. higher than anticipated, if the correct relative humidity is to be obtained. Of the two factors, relative humidity is decidedly the more important. The reason for this slight temperature excess, and an indication of the methods to be adopted to reduce it, will be considered later. The question of the influence of temperature upon mould growth has also been taken into account.

As already mentioned, each building has its own plant room or rooms containing the necessary fans for air distribution, heating batteries, dampers and automatic controls, the plant varying in output according to the requirements of each building. The essential equipment consists, in each plant, of an electrically driven fan drawing air through a suitable filter, delivering it over a heater battery into a simple plenum in the chambers.

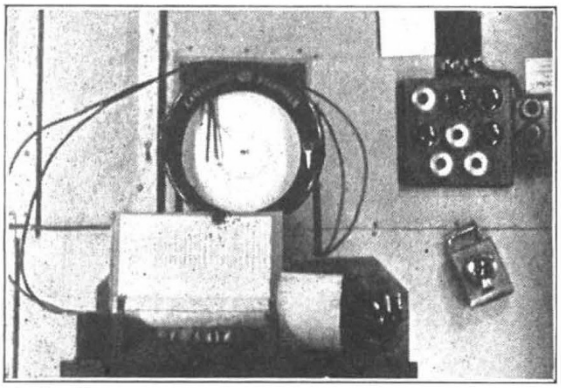

Fig. 5. HYGROMETER, CONSISTING OF DISC-TYPE TEMPERATURE RECORDER AND ASPIRATING SYSTEM.

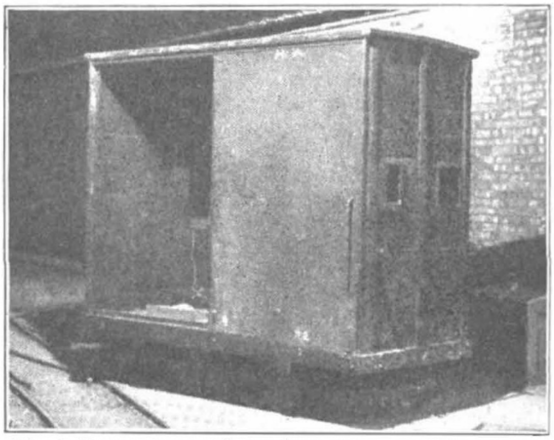

Fig. 6. CLOSED TROLLEY (ONE OF THE FOUR SIDE-DOORS REMOVED) FOR CONVEYANCE OF PICTURES BETWEEN VARIOUS STORAGE BUILDINGS.

Warm air is distributed as evenly as possible through ductwork having low-velocity outlets, and is controlled by louvre and slide-type dampers. Provision is made for partial or total re-circulation of the warmed air, and the proportion of fresh air introduced can be controlled. The unusually stable temperature conditions outside the buildings make thermostatic control as ordinarily understood unnecessary. Over-riding high-temperature protection is provided and remote warning of a rise or fall in temperature exceeding 2° F. is given.

The only variable is that of electricity supply voltage at the terminal of a long and heavily loaded rural system, and this is compensated by hand adjustment of the calibrated louvre dampers, and by switching off sections of the heater batteries. This maintains conditions well within the differential limits of commercial thermostats and without the need for heavy voltage control equipment.

Normally, the system works on almost full re-circulation of air, with a change of about four per hour. The operating cycle begins at the plant room, where a very small amount of fresh air at 47° F. and 95 per cent relative humidity is 'bled' into the system through intake louvres. The air passes into the filters, mixing with the recirculated air drawn from the chambers. Then it passes through the fan, across the heating battery, through the duct system and is delivered to the rooms through a series of suitably placed orifices. Then the air is drawn back to the plant room through 'recirculation openings' normally kept open. Excess fresh air drawn in at the plant room displaces a part of the stale air through 'evacuation valves' provided for the purpose. When fresh air is being drawn in and filtered there is always a slight outward pressure from the rooms which assists in preventing introduction of any dust from outside.

On occasions, staff is required to work inside the rooms and then the air can be freshened by opening fully the fresh air intake louvres, and closing the 'recirculation louvres'. Air escapes through the evacuation valves. For a given heat input, the temperature then tends to fall, and if the blow through is of long duration, the heat input must be increased.

The advantages of almost complete recirculation are a reduced power consumption for heating, and less heat loss to parts of the workings outside the buildings where the natural ventilation is sluggish.

There has been experience of local temperature rise to 52°–53° F. from 47° F. with decrease in thermodynamic efficiency, and to overcome the consequent rise of relative humidity in the rooms while maintaining temperature, it has been necessary to use calcium chloride as a pre-drying agent for fresh air entering certain plant rooms, and to install powerful fans to draw on the vast volume of air at 47° F. in other parts of the workings. At the worst, in one part, a maximum temperature of 66° F. has been necessary to maintain 58 per cent relative humidity. Energetic measures are being taken to introduce cool air to this locality, and shortly it is expected that it will be reduced to uniformity with the rest of the system.

The flexibility of the whole system is important. Certain valuable material needs individual treatment, and conditions in a building or part of a building can be readily adjusted without any widespread disturbance of conditions.

Throughout, it must be remembered that fungus and moulds constitute a formidable danger to pictures. Research shows that at such a modest figure as 68 per cent relative humidity, especially at temperatures of above 70° F., trouble may occur. Free circulation of air is an effective counter weapon. This is amply provided for in each building. A number of trial canvases and panels have been placed in various parts of the workings—outside the storage chambers—to observe what happens to them in air at around 47° F. and approximately saturated. Moulds were observed well within a month and, in one case, in eighteen days. Constant vigil is kept, not only on the pictures, but also on all incidental woodwork and fabric. Routine inspection is undertaken at short intervals.

The recording instruments in use are simple but essential. In every building there is a hygrometer of the type shown in the illustration. These consist of a standard double-pen disc type mercury-in-steel temperature recorder, adapted to work with an aspirating system composed of a couple of asbestos fibre tubes through which air is drawn by a small fan and motor. In one tube is the wet bulb, and in the other the dry. From the former, a suitable wick dips into a trough of distilled water. (The air-flow is at approximately the same rate as that generated by a psychrometer or whirling hygrometer.) From standard tables, and from the reading of the wet- and dry-bulb temperatures, the relative humidity in the chamber is known at any moment. Calibration with a psychrometer, as a check, is carried out at frequent intervals. These composite hygrometers have been found most satisfactory: a little difficulty was experienced initially in getting the exceptionally large amount of wick to saturate evenly and continuously, but this has been overcome. If the plants are stopped down for a couple of minutes, a decided knick is observed on the charts, thus giving confidence in rapid reaction.

Thermometers are placed at every recirculation louvre throughout the buildings, so that engineering staff can read them from the plant rooms on their patrols. A series of 'standard temperatures' have been worked out empirically, corresponding to the desired conditions within.

Outside the chambers, at various points in the workings, temperatures are recorded daily, to make sure that the ventilation remains satisfactory.

The possibility of electric power breakdowns and failures has been most carefully considered. On this account a 140 h.p. low-speed Diesel-alternator, capable of taking the whole load of motors, fans, heaters, lights and accessories, has been installed. Due to the isolated situation and the severity of local conditions, calls upon the emergency plant are not uncommon. Before the pictures were moved in, a stringent test was made, the generating plant maintaining the whole load continuously for a week. This was thought necessary in view of the reliance placed upon electric power to keep the relative humidity in the buildings from rising (within a matter of a few hours) to dangerous limits. Fortunately, circumstances are such that a more rapid deterioration is not to be expected, but there is not a great deal of margin in this respect. Almost equally important is the need for prompt—almost immediate—restoration of lighting after a breakdown. Experience has shown that it is never more than 2–3 minutes before the stand-by plant is running and normal conditions return. The double calamity of a failure of both electricity supply and stand-by plant at the same time has been envisaged, and super-emergency measures designed to mitigate such a situation so far as possible. There is, of course, staff on duty day and night. As mentioned before, an adequate (but not limitless) supply of water, capable of being treated for use in engine cooling, is at hand.

Indications have already been given of the somewhat heavy engineering works involved in this whole project. To conclude this section, some details may be of interest. Initially, the site (for the purpose in view) was practically without access. A new road, entailing some considerable excavations and embankment, was therefore constructed. Within the workings themselves, enlargement of adits and levels necessitated the blasting and removal of some 3,000 tons of rock (including work now in hand for the improvement of ventilation). In addition, a further 2,000 tons were removed by hand-labour from the floors before it was feasible to begin the erection of the storage buildings. In this enterprise a special appreciation must be made of the work of the local company's manager, under whose direct supervision these operations were all carried out. He discharged this task rapidly, and thanks to his knowledge of the local strata, without accident of any kind.

For the necessary transport of pictures and stores (including engineering equipment), the National Gallery needs about a quarter of a mile of underground narrow-gauge railway. The maximum gradient encountered is 1 in 20 for a few yards. Special rolling stock was built for it by one of the main-line railway companies. An example is shown in the illustrations. These trolleys (propelled by hand) have proved invaluable. In fact, it would have been impossible to have 'moved in' without them. Day in, day out, they are in regular use.

Future Problems

Large-scale research is scarcely practicable in a repository such as has been described, especially as the prime motive is that of conservation of the nation's great collection. Nevertheless, the future is not being left wholly to itself. A sizable body of data relating to temperature, relative humidity, condition and reaction of materials is being assembled, and may well take its place in contributing towards the post-war design of museums and galleries, and to the choice of environment considered best for works of art. It is possible that full air-conditioning of such institutions in large cities and certain other places might be found to be financially desirable, when the sums spent annually in restoration and repair of paintings are critically reviewed. Careful inspection will always be needed, but the experience so far of housing a collection of pictures below ground under controlled conditions, scientifically planned, is decidedly encouraging. It would be a pity if some of this could not be translated into terms appropriate to times of peace. Many great pictures are probably now going through severe hardships and many vicissitudes. Those for which the Trustees of the National Gallery are responsible, however, are at present enjoying a climate of such salubrity that the greatest problem for the future is to foresee how they will react when they leave it.

WILD BIRDS AND HOME-GROWN FOOD IN BRITAIN

By DR. WALTER E. COLLINGE

WRITING in NATURE in July 1918, I stated: "It behoves us to awaken and to take heed where we stand, or for some years to come our land will groan with the cry of desolation, due to our apathy and the ignorance and neglect of the ways and habits of our insectivorous birds, and the wanton destruction of what has ever been Nature's means of adjusting the complications of animal life, which man in his ignorance is seeking to pervert". In the quarter of a century which has since passed, the nation has lost millions of pounds worth of home-grown food.

For very many years past, I have given warning of the vital importance of framing a sound and logical policy relating to the protection and destruction of wild birds. To a very large extent this warning has fallen on deaf ears. Little or nothing has been done, the *laisser-faire* policy has been pursued, and at the present moment it looks as if Nemesis were about to overtake us. No useful purpose would be served by re-opening here the whole question. It is a difficult one, touching various interests and prejudices; but we must no longer shut our eyes to the various extremely dangerous suggestions that are being so widely circulated, and, I fear, in some cases being put into practice.

At the moment, the whole of Great Britain is deeply concerned in the production of the maximum amount of home-grown food and in being able to harvest it. In so far as it lies in the range of human endeavour, there must be no mistakes made that will lessen the harvest of 1943. We now know that big, clean crops of all kinds can be raised and harvested, provided they are kept free from pests and disease. Such pests as wireworms, leather-jackets and other soil-inhabiting insect larvæ exact an enormous toll on root and cereal crops. In a like manner, the larvæ of various moths and flies, and also aphids, take their toll of the fruit and other crops. The soil may be treated with various chemicals and the fruit trees sprayed, but both are only partial remedies and both processes are expensive and demand man-power.

Two primary facts stand out, namely: (1) Wherever the insectivorous birds of a district or districts are destroyed, either purposely or through climatic or other causes, there is an accompanying insect oscillation which is not reduced until the balance of bird life is restored. (2) In the case of certain insects the numbers of which remain relatively constant, the controlling influence is largely, if not entirely, due to the uniformity of the bird life from year to year.

Nearly sixty years ago, John Curtis told us that if the depredations of injurious insects could be brought under control "the benefit would exceed everything of which at present we have any conception". The amount of insect food that insectivorous birds will eat is very large. I have given the following as an illustration and in an endeavour to bring the fact home to the public. Assuming that there are 32,000,000 acres of land under cultivation in Great Britain and that we have a pair of birds to every four acres, these 16,000,000 would consume annually 135,411,328,000 insects, and these would be destroyed just at the season of the greatest agricultural activity and would be accomplished without any outlay of men or money. Yet it now seems that ill-informed people are advocating the destruction of rooks, gulls, blackbirds, thrushes and other insect-eating birds.

Very briefly, let us examine the facts concerning the few species of useful birds mentioned above.

Rook. During the past fifty years, this species has received more attention as regards its food habits than any other British species, and the general consensus of opinion is that this bird is economically of the very greatest value. The nature of its food has been shown to consist of large quantities of injurious insects and their larvæ, some of which are most difficult to destroy and which annually exact a huge toll on the produce of the land.

Sea-gulls. No more short-sighted policy than that of the destruction of sea-gulls has ever been promulgated, and if carried out will have results of a most devastating nature. We have at last given up the foolish idea that sea-birds generally feed only on fishes and therefore are impoverishing the supply. Nay, we have still further advanced, for we now realize that, so far as sea-gulls are concerned, the percentage of fish eaten is comparatively small, very small in some cases, and much of it is obtained from the garbage of the shore.

The black-headed gull—the bird that follows the plough—for the greater part of the year feeds upon injurious insects. The total percentage (stomach contents) for the year is 24·70, whereas the fish content is 3·73 per cent. The highest fish content for any month in the year was in November, with 12·85 per cent, whereas the percentage of injurious insects during April to October was 33·01, with the following figures respectively 32·96; 28·0; 37·30; 31·38; 38·83; 26·62; and 26·0.

"Of 664 specimens examined only 143 contained fish remains and 267 contained no marine organisms whatever."[1] For the common gull the figures were, injurious insects 14·66 per cent, fishes 5·16 per cent, and for the herring gull 9·52 per cent and 17·55 per cent respectively.

Blackbird. In 1924, I pointed out[2] that we had too large a resident population of blackbirds. From numerous observations made by myself and many correspondents, there was no doubt that the popula-