and would refuse it even if liberal financial assistance were provided.

Dr. J. F. Mountford, vice-chancellor of the University of Liverpool, followed with a consideration of the technique of selection of students. He pointed out that any technique of selection must operate against a background of theory respecting the kind of persons we want in universities and of information about the national requirements, both of which are lacking. He reviewed the value of examinations, recommendations, school records and intelligence tests as means of selection and showed that all are faulty, though he suggested that more use might be made of a carefully devised system of school recommendations, in regard to which we might learn something from American practice. Interviews, while sometimes useful, are tricky and are impossible where very large numbers are concerned. Dr. D. R. Pye, provost of University College, London, gave an interesting account of a system of intelligence testing, requiring relatively little time, which has been experimentally adopted for medical entrants at that College. The chairman stressed the widespread use of intelligence tests, apparently successfully, by American universities.

The final session, under Sir Hector Hetherington, vice-chancellor of the University of Glasgow, considered "The Proposal to Establish a Representative Universities Council". The discussion was opened by Lord Simon of Wythenshawe, chairman of the Council of the University of Manchester, who pointed out that a powerful dual planning organisation, in the University Grants Committee and the Vice-Chancellors' Committee, is already in existence, with a good record of work accomplished. He put the question: What would be the functions of the new body? Prof. S. Brodetsky (Leeds) and Lord Chorley (London School of Economics), on behalf of the Association of University Teachers, both supported the proposal for a new council, which would include representatives of the university teachers and hence might have a realistic approach to its problems. Some apprehension was expressed by other speakers lest the council should trespass on the liberties of the universities, and Sir Walter Moberly made it clear that the University Grants Committee did not welcome the scheme. The chairman then ably weighed up the arguments and concluded by advising that there should be a continuation of these annual conferences, perhaps associated with preliminary regional conferences, rather than a new body. With this suggestion the Conference concurred.

The overall picture drawn by the Conference, of the universities of the United Kingdom between the upper millstone of Government pressure to expand and the nether millstone of crowded entries, creaking with overstrained machinery and ringed by shortages, was not encouraging, and showed how much need there is for the continued consideration of their situation by representative conferences.

The criticism might be levelled at this, as at many other conferences, that there was a tendency to skate round the fundamental issues, and Prof. Bartlett's challenge to consider the type of man we want to turn out from the universities was unanswered. The Conference was not ready for it; but, after all, it is still in the experimental stage, and greater experience will no doubt bring greater potentialities.

Practical-minded people expect workaday results in the form of resolutions, appeals, protests and the like; but these things, whatever value they may have,

are not to be looked for from a conference the first aim of which is the free exchange of ideas between men of common interests, who would never otherwise meet together. In fulfilling that aim the experiment may be pronounced successful, and we may look with hope for its further development.

Grateful thanks were expressed to Mr. J. F. Foster, secretary of the Universities Bureau, who organised the Conference, and to the University of London, which was host for the occasion.

R. C. McLEAN

CLEANED PICTURES AT THE NATIONAL GALLERY

By DR. H. J. PLENDERLEITH

THE Exhibition of Cleaned Pictures (1936-47) which opened at the National Gallery on October 9 is of unusual interest. Some seventy odd masterpieces are exhibited and all of them have been cleaned since the autumn of 1936. They are displayed for the first time without glass, on clean walls with auxiliary fluorescent illumination. Documentation is made available relating to the history of the pictures, in particular to their preservation and to any new facts revealed by cleaning: there are photographic records, studio reports and, from the laboratory, radiographs and scientific data collected in the course of diagnosis or for the purpose of making permanent records before, during and after cleaning.

The exhibition is served by a catalogue which explains the conditions in detail. The foreword by the Director of the National Gallery sketches the history of the national collection and shows how cleaning policy has varied since 1824, the date of foundation; and it outlines the main controversies (three in number) which have arisen on the subject of picture-cleaning during this time. In 1853, a Select Committee of Enquiry of the House of Commons put an end to the evil practice of applying to the pictures a varnish containing boiled oil. This varnish on ageing provided the golden colour which has too long been considered in the public mind to be the stamp of an old master. The old masters themselves have something to say on the matter—Rubens, Hogarth, Reynolds and Constable. They appeal with one voice for the protection of their works against whatever factors cause the yellowing of paint, and in doing so place a serious responsibility on posterity.

The exhibition is frankly experimental in character. While picture-cleaning is the central theme, the opportunity has been taken to stimulate interest in other aspects of practical curatorship. The visitor is introduced to some of the problems of preservation, storage and exhibition as they exist in the post-war National Gallery, and led to appreciate something of the care and control that goes into the safeguarding of our national patrimony of art.

Picture Cleaning

For many, the idea of cleaning pictures must be novel. It arises generally from the necessity of removing old varnish which has become yellow, shrunk and hardened, in which condition it causes a misrepresentation of the original colour and promotes cracking and the eventual disintegration of

the underlying paint film. There is general agreement that the cleaning of pictures in the interests of their survival is an unfortunate necessity. Cleaning is followed by restoration, and this may mean anything from spotting out lacunæ caused by the flaking of old paint, to replacing a rotten canvas or panel by a fresh support. After restoration the picture has to be re-varnished, and this is carried out with the two-fold object of protecting the surface and of bringing the optical quality of the work, so far as possible, to the key intended by the author of the painting.

The resin selected for making picture-varnish is exclusively mastic: this is dissolved in turpentine without the application of heat. A coat of mastic varnish may remain protective for about fifty years under museum conditions, by which time it usually requires replacement. It will seem strange that such an impermanent varnish is preferred, and there is undoubtedly need for research in this direction. The advantage of mastic is that, irrespective of its age, it can be removed, with ease, by solvents which have no softening effect on the underlying paint film—a fundamental requirement of any varnish designed for artistic purposes. No permanent varnish is as yet known which possesses this property and is satisfactory in other respects.

During the present century, the incidence of cleaning at the National Gallery has been very irregular. For a variety of reasons, less than one picture a year was cleaned between 1900 and 1933, and thus there are large arrears of work requiring urgent attention. The war years during which the pictures were in exile provided an excellent opportunity to make up leeway with the minimum of inconvenience to the public. But it has been possible to treat only the most urgent cases: arrears of cleaning still continue to give rise to official concern.

Standard of Criticism

"The purpose of the exhibition," states the catalogue, "is not only to do justice to the cleaned pictures, but by extending the knowledge of their condition to bring about a higher standard of criticism." It is recognized that public criticism is important to the vitality of any picture gallery; and thus the present exhibition, while providing data for a reply to points of controversy which have been raised in the Press, is designed at the same time to stimulate interest in technical matters and to encourage criticism to develop along constructive lines so that its highest aims may be served.

Can controversy be avoided, it may be asked, when the issue is one of both fact and feeling, condition and appearance, and where there must be, inevitably, ample ground for antagonistic points of view? The answer is that it certainly cannot, and this is, perhaps, all to the good. But in the special case where criticism depends upon incontrovertible fact, whether ascertained or ascertainable, the fact must be recognized and accepted by the critic, otherwise his criticism falls to the ground and does credit to no one.

The significance of the present exhibition is its contribution to factual evidence: we have, in this age, methods of recording facts and of non-destructive testing either undreamed of in a previous generation or refined to the extent of being precision instruments in the hands of the expert—methods of collecting data which can be used in turn for testing the validity of criticisms, or for revealing imperfections

in the technique of cleaning and restoration. It is a large step from the 'make do and mend' policy of 1824 onwards to the techniques advocated by the International Conference of Museum Experts, Madrid, 1934¹. If one studies the history of conservation, one must be impressed by the far-reaching developments in both diagnosis and treatment. Unless criticism is prepared to advance in sympathy, it must lose, inevitably, in significance.

Scientific Inquiry

In the present age, the laboratory is as important to curatorship as is the library, and the National Gallery is fortunate in possessing a laboratory well-equipped for physical investigations, and already of international repute; and shortly to be extended in scope so that chemistry can also play its part and make contributions to the preservation and study of paintings. The value of the laboratory lies in the objective character of scientific inquiry.

For example, allegations concerning damage to Rubens' "Chapeau de Paille" were shown to be fallacious by the microscope and micrometer. Small passages of greenish-blue colour alleged by a critic to be all that remained of Rubens' original background (which, it was suggested, had been removed by drastic cleaning) were shown to underlie the main blue background by at least 0.02 mm., thus vitiating the suggestion. Rubens had overpainted this greenish-blue to eliminate much of the green; but this, of course, could not be appreciated until, in the course of cleaning, the removal of yellowed varnish allowed the eye to differentiate between blue and greenish-blue. The change in appearance is merely the revelation of truth. More is now known of Rubens' technique, and a certain mental adjustment is required to bring this latest phenomenon within our conception of Rubens' studio method. When the facts are digested, parallels are discoverable in other work by the same master, as the catalogue points out.

The value of soft X-rays in the study of painting is demonstrated by the quality of the radiographs on exhibition. Changes in colour can be followed by readings taken on a tintometer: cleaning swabs can be spectrographed or submitted to chemical analysis; and photographic recording by ultra-violet or infra-red illumination or by the use of coloured filters can add still further to the stringency of the control of cleaning operations. Photo-micrographs and macrographs play their part.

Cleaning and Restoration, Good and Bad

A photograph of the forehead of the (restored) Velazquez "Philip IV", taken at about $\times 4$ diameters, is shown in the exhibition. On comparing this with a similar photograph of the picture after cleaning and before restoration, it is clear that many tiny lacunæ have been 'in-painted', that is, restoration paint has been prevented from overlapping the original. The work is done superbly well: the art of restoration has developed with the means of controlling it. In former days over-painting of damaged areas was the rule (compare photograph of the forehead of "Philip IV" before cleaning); and it was even the case that coloured varnishes (anathema to-day!) gratified the æsthetic senses of our predecessors. It need scarcely be said that tinted varnishes were much in favour with the dealer and restorer, in their time, as they served to conceal imperfections of condition and technique.

In some circles the idea still persists that in cleaning a picture there is a positive virtue in avoiding the complete removal of the old varnish, this being claimed as a mild form of treatment. It is a specious argument, and the practice is only in favour in commercial *ateliers* where saving in cost is a factor or where there is lack of confidence or ability on the part of the restorer. It is to be condemned for the following reasons. First, because the use of feeble solvents necessitates using friction, and the rubbing of the surface of the painting tends to remove ridges of paint in the brush-work or crackle system. The hollows of the impasto and the crackle tend, inevitably, to become filled with a brown residue consisting of the least soluble constituents of the old varnish. There is this, also, to be said, that a picture so treated will speedily darken to the point of requiring re-cleaning, and the net result is that the incidence of cleaning is increased. Residues of the old varnish may well promote crystallization of the new. The practice of treating pictures along these lines cannot be too strongly condemned. One admits, however, with reluctance, that circumstances may occasionally require a compromise to be made. When this is so it can only be in favour of dark passages of colour: from light pigments and bright colour, all of the old varnish must be completely removed, and the degree of success of the operation can be followed in the laboratory by examining the painting under screened ultra-violet illumination, when the old resin residues are seen to fluoresce unmistakably.

Atmosphere and Stability

While pictures are re-conditioned by cleaning and restoration, their preservation is entirely dependent on the conditions of humidity and temperature in the picture gallery.

When humidity and temperature are uncontrolled, the day and night changes occasion rhythmic movements in the panels and canvases. These may be slight; but in the aggregate they have a deleterious effect on the stability of the paint layer. A consequence is the appearance of blisters in the paint, caused usually by cleavage between the ground and the support, and in the course of a year many are discovered and 'laid' by competent craftsmen. If undiscovered, the next stage is fracture and exfoliation of the paint, necessitating more serious treatment. Extreme atmospheric conditions or changes of condition are liable to cause catastrophe, such as disruption of the constituent planks of Holbein's "Ambassadors" panel (February 1895), or the splitting of Rubens' great "Château de Steen" (January 29, 1947).

It took experience of the war-time repository to bring out the fact that under controlled conditions of humidity and temperature ('conditioned air') no blisters form; there was practically no maintenance work of this kind required at Manod Quarry² in the course of years. The moral is obvious and of the greatest significance to the preservation of paintings: conditioned air must be accepted as essential for picture galleries. In the national collection, which is so rich in large Italian panels, a grave responsibility rests upon all who realize what is at stake. This is understood and accepted by the authorities, who, with the help of the Ministry of Works, have improvised a 'hospital' behind the scenes, and here by the aid of primitive controls the relative humidity can at least be held in check. By this means a

floating population averaging some thirty 'ailing' pictures is saved, temporarily, from exposure to the more extreme climatic conditions of the public galleries.

It is with relief that we learn that a scheme for installing conditioned air in the National Gallery is in being. The apparatus exists already on the site. Plans have been approved for the first experimental section, and we can look forward to the coming of an era—let us hope it may be soon—when the building will be worthy of its great collection of pictures, cleaned by the enlightened methods of to-day, so that all in their generation may enjoy the work of the old masters as they themselves would have wished.

¹ "La Conservation des Peintures" (L'Institut International de Co-operation Intellectuelle, Paris, 1939).

² Rawlins, F. I. G., *Nature*, 151, 123 (1943).

HYPOTHETICAL ALTERNATIVE ENERGY SOURCES FOR THE 'SECOND MESON' EVENTS

By DR. F. C. FRANK, O.B.E.

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IN the paper by Lattes, Occhialini and Powell*, it is shown that cosmic ray mesons coming to the end of their track in a photographic emulsion rather frequently give rise to a secondary meson of kinetic energy about 4 MeV., and no other visible particle. This observation appears to demand for its interpretation the existence of two sorts of meson, the source of the observed kinetic energy of the secondary residing in the mass difference between the two. In view of the importance of this conclusion, we have tried to consider all reasonably imaginable processes to explain the observations without introducing a new elementary particle; processes, that is, in which the energy is derived from the material of the photographic emulsion instead of from the meson. Reasons are given below for the confident rejection of all such processes.

It is concluded that there is no energy to be gained, from elements present in substantial quantity in the photographic emulsion, from the following processes:

(a) Induced β - or K -capture processes: on grounds of known mass defects for the lighter nuclei, and systematic principles for the heavier nuclei present. There should be energy (though not enough to explain the observations) to gain from such processes from K^{40} , Rb^{87} , Lu^{178} , Os^{187} and from one each of the pairs In^{113} , Cd^{113} , Sn^{115} , In^{115} , Te^{123} , Sb^{123} ; none of these is present in substantial quantity. It is improbable that any natural nucleus possesses a more stable adjacent isobar not discovered in Nature.

(b) Induced emission of single nucleons: on grounds of known mass defect for the lighter nuclei and systematic principles for heavier ones; such processes, from naturally existing nuclei, always absorb energy.

(c) Induced α -emission: excluded for the lighter nuclei by known mass-defects. Not excluded for the heavier nuclei, since mass defects are not known with sufficient accuracy, and by the Geiger-Nuttall rela-

See *Nature*, 160, 453 and 486 (1947).