

During two years, half the time is devoted to research and half to preparation for a professional degree. At the end of the period these students enter the research department of the firm.

The Mellon Institute of Industrial Research, attached to the University of Pittsburg, was erected by Mellon Brothers, bankers, to provide manufacturers with the use of a well-equipped laboratory and trained staff at less cost than the establishment of a works laboratory. Any manufacturer requiring a subject investigated can endow a fellowship for one or more years, paying from 100*l.* to 400*l.* and also the cost of any special apparatus. The building cost 50,000*l.*, and the equipment 16,000*l.* A staff of seven men of high attainments supervises the researches. The director of the institute selects the fellows, usually men with a doctor's degree. Seventy-five fellows have been appointed in five years. The total amount spent in salaries and maintenance is 30,000*l.* a year.

A National Research Council has recently been appointed by the Academy of Sciences, at the request of President Wilson, to co-ordinate the scientific research work of the country.

The report, of which this is a very brief account, is extremely comprehensive, and should be read by all interested in the industrial progress of this country. The author draws some general conclusions, and suggests the establishment of an Imperial Industrial Research Laboratory, say, in the Midlands, controlled by a board largely composed of manufacturers.

#### RAINFALL AND GUNFIRE.

**M.** ANGOT, the eminent director of the French Meteorological Service, has made a valuable and authoritative contribution, published in the *Journal of the French Academy of Agriculture* for May, to the literature of a well-worn controversy. The alleged connection between rainfall and gunfire, in favour of which so many champions sprang up during the wet periods of 1914-16, has recently lost favour as a subject for argument, owing, no doubt, to the coincidence of the spring drought of 1917 with the Allied offensive on the Western front; but so short is the public memory, especially for negative evidence, that the incidence of 3 in. of rain during a recent summer afternoon in North-West London has proved sufficient to disinter the bone of contention. The mental attitude of the public towards a theory of this nature is of great psychological interest: there is little doubt that, should we experience this summer a repetition of the weather of July, 1888, when snow fell in London, followed by a recurrence of that of August, 1911, when the thermometer touched 100° F. at Greenwich, both phenomena would generally be attributed to the war.

Accordingly M. Angot's paper reaches us at an opportune moment. After dealing briefly with the historical aspect of the question, and alluding to the work of M. Le Maout—who, not content with having established a connection between the bom-

bardments of the Crimean War and the rainfall of India, the United States, Nicaragua, and Barbados, went on to ascribe the diurnal variation of the barometer to the striking of public clocks and the ringing of church-bells—M. Angot proceeds to consider the physical changes which could be effected by the discharge of artillery, and could at the same time be held responsible for the causation, increase, or acceleration of rainfall.

The first proposition is that a succession of violent explosions might result in the displacement of masses of cold air at certain heights, which, coming under the influence of the upper winds and encountering layers of warmer, saturated air, could give rise to precipitation which would not otherwise have occurred: in this connection the author points out that in order to obtain a rainfall of so small an order as 1 mm. (0.04 in.), even if one were to take two equal masses of saturated air, the one at a temperature of 0° C., the other at 20° C. (an extreme case, of course), it would be necessary to effect a rapid and thorough intermingling of the two throughout a layer of air 6850 metres in thickness. In M. Angot's opinion, the mixing of layers of air may be the cause of cloud-formation or of slight drizzle at the earth's surface, but can never be responsible for considerable precipitation.

In the case of the second proposition—that water-vapour resulting from chemical reaction of the explosives might take effect—it is asserted that in order to produce the same amount of rainfall (1 mm.) as in the previous proposition the employment of no fewer than 21,750 tons of melinite per square mile would be necessitated—that, indeed, only on the supposition that all the hydrogen in the explosive became water-vapour which condensed immediately in its entirety and, so to speak, on the spot.

In the third and last instance, the possibility of electrical action being brought into play is considered in some detail. We know that super-saturated air (*i.e.* air which contains more water-vapour than it normally should be able to hold for the existing temperature) is a physical possibility, in the absence of dust-particles or other matter which may form nuclei for condensation. The necessary medium may be supplied by the action of ozone, of ultra-violet rays, by any cause, in fact, which can set up ionisation of the atmosphere; under this last category may be classed the detonation of high explosives, inasmuch as highly ionised gases result therefrom. The lower regions of the atmosphere, however, which alone are the seat of explosive activity on a large scale, always harbour large numbers of both ions and dust-particles, and cannot, therefore, be subject to supersaturation; while it has yet to be shown that the addition of quantities of ions or of dust-particles to a stratum of atmosphere nearly, but not quite, saturated can bring about premature condensation. Assuming for the moment the possibility of such a hypothesis, we must consider that no outpouring of ions or dust-particles can do more than accelerate a precipitation which would be necessitated sooner or later

by the progressive cooling of the air, since the mass of water that results from the cooling of, say, a kilogram of saturated air from 15° C. to 0° C. is constant (rather more than 5 gr.), whether or not supersaturation may have existed at the inception of the temperature-reduction.

Having thus pronounced upon the theories which have been advanced to account for the alleged connection, M. Angot goes on to consider whether in reality anything has occurred that needs accounting for—whether the rainfall since the outbreak of hostilities has been less inclined to observe the rules by which we endeavour to forecast its occurrence than before. Careful comparison between the daily weather-maps and the observed rainfall figures has convinced him that it is not. He points out, very rightly, that we have been passing through a series of wet years since 1909—a period that balances the run of dry years 1898–1904 (1903 and 1911 were both exceptions to their groups and may be said to balance one another)—and that excess of rain in 1915 and 1916 might reasonably have been expected; that 1909 was wetter (in France) than 1915, 1910 than 1916; furthermore, that during December, 1915, an unprecedentedly wet month, relative calm prevailed over the whole front, and that in the second ten-day period of the very wet February of 1916 considerably more rain fell (40 mm. as against 28 mm.) than in the last ten-day period, which witnessed the development of the giant German bid for Verdun. Similar conclusions will be reached if frequency of rain instead of amount be considered: 1910 had more rain-days than 1916; 1912 and 1913 both more than 1915, when the number in France was eleven below the average. The author has found nothing exceptional in the local distribution of rainfall: proximity to the firing-zone has not resulted in relatively greater totals or frequencies, while the great spring offensive of 1917 failed to interrupt the long spell of brilliant weather which accompanied it.

An examination was made some months ago at the British Meteorological Office into the local distribution of rainfall over England during the first twenty-two months of the war, the results of which afford corroborative evidence for M. Angot's last-mentioned point. It was found that the greatest excess of rain over the normal figure was one of 59 per cent. on the South Yorkshire coast; that three areas in Lincolnshire and on the Norfolk and Suffolk coasts respectively had rather more than 40 per cent. excess; but that round the North Foreland there was a slight deficit. No trace whatever of a distribution having reference to a centre over northern France was discoverable.

M. Angot concludes with the reflection that it may be with rainfall and gunfire as it is with weather changes and the phases of the moon, that "sous la suggestion d'une croyance instinctive on est conduit involontairement à ne remarquer que les coïncidences favorables et à s'affermir ainsi de plus en plus dans cette croyance." For those, indeed, who are cognisant of the relationship between the weather and modern warfare it is not difficult to

see the possibility of the connection, but it is a connection in which the amount of gunfire varies inversely as the amount of rain that is falling rather than one which makes the rainfall in any way dependent upon the gunfire.

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#### NOTES.

M. PAUL OTLET, who is director of the International Institute of Bibliography at Brussels, has published a long and interesting memoir in the May-June number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* on the question of the establishment, in Paris, of a Central Information and Records Office for Industry. There are already in existence a certain number of enterprises of the kind, such as the *Mois Scientifique et Industriel* in France, the *Engineering Index* in England, and the *Repertorium der technischen Wissenschaften* in Germany, but their scope is limited. According to M. Otlet, the scheme should assume an international character, and its functions should be the collection, classification, and dissemination of all information available, both French and foreign, which will tend to facilitate and develop industry. A mere catalogue of works on particular subjects is not alone sufficient; a bibliography should be included in the scheme, so as to afford more detailed information on any desired subject. Books of all kinds, pamphlets, catalogues, descriptions of processes, journals, standard reference books of all countries, plans of machinery and plant, where available, a complete set of patent specifications, prospectuses of educational establishments, etc.—all would be collected and classified in accordance with a plan definitely laid down beforehand. Extensive card or similar indexes would be compiled for reference, and a complete catalogue on the decimal system, together with a bibliography, would be published at definite intervals. All these works would be available for free consultation by interested parties. Authors and publishers would be invited to co-operate in order to ensure the success of the enterprise. Existing publications, e.g. the International Catalogue of Scientific Literature, would be used as the nucleus of the work. It is to what the author calls the science of "documentation" that the Germans owe to a great extent the place they have attained in the industrial and military world, although they have often employed unscrupulous means to reach their end. He suggests that every industrial concern should have its own information and records department, which should be planned on the same lines as the national establishment, with which it should keep in touch. In connection with the question of patents, it was suggested at the Conference of Allies held at Paris last year that an international patent office be formed after the war, to save the time and expense now required for taking out patents in various countries. An undertaking of this nature would greatly increase the necessity for a more elaborate—practically an international—Record and Information Office to enable all questions of priority and infringement to be dealt with efficiently. Every phase of an important subject is reviewed in this memoir of thirty pages.

WITH a view to the just apportionment of pensions due to soldiers for injuries received in the present war, the French Government has established at Paris, at the instigation of Dr. Camus, a well-known military surgeon, a special centre for determining scientifically the extent of incapacitation. This establishment will serve both as a research laboratory and for the additional treatment of those who have already undergone the usual hospital treatment. Here special