NATURE

No. 3834 SATURDAY, APRIL 24, 1943 Vol. 151

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Telephone: Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

CONTROL OF CHEMICAL AND MINERAL PRODUCTS

IT is generally agreed that the restraint of potential aggressors must be a prolegomenon to any planned reconstruction of the post-war world. History does not provide us with any comforting hopes in this connexion, but during this last German war the tempo of destruction, cruelty and misery (and also that of lying and slandering) has risen so greatly, and physical means of communication and control have developed so rapidly, that the prospect of curbing Mars, if not of slaying him, may no longer be regarded as chimerical. It is also generally agreed that the measures prescribed to this end at Versailles in 1919, and in subsequent treaties and pacts, have failed dismally. In what directions, then, shall we now look ? Having experienced the futility of pious pacts and the boomerang effects of vindictiveness, shall we now pin our faith to an effective international police force ? Shall we make ourselves overwhelmingly strong, and keep our potential enemies so abjectly weak that they cannot have recourse to war ? Or could we by some political *tour de force* succeed in segregating or dispersing dangerously hostile populations with the view of incorporating them in some stable, peace-abiding confederation ?

In the long run, the will to war might be eradicated by what is called a 'change of heart' ; in the shorter run, much progress in the desired direction could probably be achieved by a drastic reform of current educational methods, and by implementing an all-round policy of social security. But long before such changes could be effective, some means—political, economic, technological—must be taken to cut the claws of any lurking beast of prey, if only to give the world breathing-time to recover from its present plight. If the beaten enemy is again allowed to attain a 'giant's strength', he will again not hesitate to 'use it like a giant'. At the same time, it is well to remember that "Who overcomes by force, hath overcome but half his foe".

Any one nation that undertook to make and keep itself overwhelmingly strong in the military sense would incur a crippling economic burden, a grave deflexion of man-power from truly constructive to purely destructive ends, and an unhealthy maintenance of the martial spirit. To keep potential enemies in a permanently weak state, physically, economically and politically, would foster among them a sense of frustration, bondage and injustice, and thus sow the seeds of a future war. In any event, for many years to come we must learn from our fateful experience of the past one hundred and fifty years, and be prepared militarily for a sudden emergency ; and any long-term policy we adopt must be so conceived that, while restraining the martial powers of potential aggressors, it does not jeopardize the success of any future eirenicon.

The profound horror evoked by the mass murder of non-combatants, by the brutalities committed in concentration camps, and by the persecution of Jews and other subjugated peoples might readily lead to

ruthless repression and even to biological reprisals. Such policies would, however, be virtually sentence of extermination ; they would do nothing for the betterment of human relations. Like greed, vindictiveness can easily overreach itself.

A less drastic, and probably a thoroughly practical proposal, would be to place an embargo on the importation of certain raw materials that are essential to war-time use. This was the policy put forward, in respect of 'key' minerals and metals, by Sir Thomas Holland before the South African meeting of the British Association in 1929, and again under the same auspices at the Conference on Mineral Resources and the Atlantic Charter, in July 1942 (see NATURE, Sept. 26, 1942, p. 364). No nation possesses within its own territory all the resources that would be adequate to conduct a long war, or for that matter to thrive economically in time of peace. For example, Germany and other parts of central Europe lack nickel, manganese, chromium, tungsten, cobalt, molybdenum and vanadium, and such substances cannot be produced synthetically, like petroleum, rubber, fibres and camphor. In view of the development of carrier-aircraft, there might well be difficulty in preventing the importation of 'key' materials required only in relatively small amount, for example, platinum and the rarer metals and minerals, but in general such a ban on exotic 'key' materials would do much to deprive an aggressive Power of the means of continuing a protracted war, provided always that there was an international authority adequate to control the ingress of supplies.

Another method of disarmament was suggested by Sir Robert Robinson at the annual luncheon of the Parliamentary and Scientific Committee, namely, to prevent the manufacture of war-time explosives by abolishing all large-scale plants making synthetic ammonia, and plants making methanol, as these can be used for making ammonia. In this way, the large-scale production of nitric acid, which is the basis of practically all explosives used in war, could be effectually stopped. No explosives—no war, was his thesis.

It may be recalled that before the War of 1914–18, nitric acid, for all purposes, was made almost exclusively from Chile saltpetre by interaction with sulphuric acid, but that shortly before its outbreak, Germany had elaborated and established the Haber-Bosch process of making ammonia by fixation of atmospheric nitrogen, the ammonia being oxidized to nitric acid by the Ostwald process. By this means Germany made herself entirely independent of imported nitrate for the manufacture of explosives and for use as fertilizer. After that War, many countries, including Great Britain, adopted the Haber-Bosch process, a modification of it, or some other process of fixing atmospheric nitrogen. To-day there are many such plants dotted over the civilized world ; and of recent years their combined productive capacity has been well in excess of peace-time demands. The result is that none of these countries need, in case of emergency, import a single ounce of Chilean nitrate (though there is plenty of it still available). The synthetic ammonia works in Germany (but not the ammonia-oxidation plants) are concentrated in a few centres, and Sir Robert Robinson believes that an International Nitrogen Commission would have little difficulty in maintaining the 'sanction', though he would allow the manufacture of sulphate of ammonia after a term of years. No mention was made, however, of the fact that a very large amount of ammonia is obtained as a by-product in the manufacture of metallurgical coke and of town's gas. There is little doubt that the works producing these products could be considerably enlarged or the number of them be increased ; the gas-works are widely dispersed, and supervision of them would entail a vast amount of police work.

The elimination of the huge synthetic ammonia works, and the ensuing drastic reduction in output of nitric acid, would put a temporary check on the production of explosives, but it would also have other consequences. It would deal a very serious blow to various peace-time chemical industries in the controlled countries, and so react adversely on their economic status. Ammonia, besides being used for the manufacture of nitric acid and such important fertilizers as sulphate of ammonia and ammonium phosphate, is also used in the manufacture of alkali by the Solvay process, and as a refrigerant, etc. Nitric acid has also a multiplicity of applications. It is of paramount importance in the manufacture of dyes and intermediates ; in fact, it is difficult to imagine a dyestuffs industry without it. There is also to be considered the possibility, if its large-scale manufacture from synthetic ammonia were banned, that another technical process of manufacture might arise in its place, such as one based on the use of ammonifying and nitrifying bacteria, which play so important a part in agriculture.

Among other 'key' chemicals of which the production might come under the ban, sulphuric acid is of first importance, being used not only in the manufacture of explosives, like nitroglycerine, gun-cotton and T.N.T., but also in a host of other industries, either as a starting material or for purifying and refining purposes. Although a process for making sulphuric acid from calcium sulphate (as gypsum or anhydrite) was worked out in Germany about the time of the War of 1914–18, practically all of it is still made from sulphur, obtained mainly from the United States, or from pyrites, derived chiefly from Spain or Norway. It would probably be much easier to prohibit the importation of these raw materials than to police a whole country with the object of preventing their use in sulphuric acid plants. Of other chemicals, apart from metals and metallic compounds, that are needed for war-like purposes, it may be said that the majority can now be produced from indigenous raw materials. Thus phosphorus, for use in incendiary bombs, etc., can be extracted from bones and low-grade phosphatic minerals ; glycerin, which is normally derived from natural fats and fatty oils, can now be made synthetically ; calcium carbide, ethyl and methyl alcohols, ether, acetic acid, acetone and formaldehyde, phenols and urea needed for plastics manufacture—all these can be produced from raw materials that are close at hand.

It appears doubtful, therefore, whether the suppression of the large-scale manufacture of 'key' chemicals, or, in fact, of any vital manufactured product, would be so promising as a measure of restraint as the control of the importation of 'key' minerals and metals. Both suggestions will have to be given careful consideration. But for any such measure to be really effective, there must be a much greater degree of co-operation among the peace-loving Powers than any we have seen in the past. Disarmament in the literal sense will no doubt be the first step, the *terminus a quo* for the long, long journey to the *terminus ad quem*, international pacification, the speed of which would be accelerated by some far-sighted political action, such as the dispersal of potentially hostile or recalcitrant minorities into regions where they would be harmless, and the incorporation of them into larger peace-abiding confederations possessing the maximum amount of freedom consonant with international security.

JOHN RAY

John Ray, Naturalist

His Life and Works. By the Rev. Dr. Charles E. Raven. Pp. xix+502. (Cambridge: At the University Press, 1942.) 30*s*. net.

NO one who studies with attention the historical development of biology can be long in doubt as to the place to be assigned to John Ray. It may be, as Dr. Raven suggests, that his name is not so well known to present-day biologists as it was to those who founded the Ray Society a hundred years ago; but, if so, it must be because the present-day biologist tends regrettably to be uninterested in the history of his science and, no less regrettably, to regard classification as no concern of his. Not that Ray imagined, as Linnæus did, that systematics was the end and aim of natural history; but to the botanists and zoologists of the seventeenth century, faced by the bewildering variety of living things, classification was the primary and most pressing need. Ray approached the problem in a spirit in many ways surprisingly modern. Others had arranged animals and plants as fitted the subject under discussion, geographically, ecologically, or on the basis of their utility to man. It was Ray who first clearly expressed the conception of a 'natural' classification based solely on structural resemblances and differences; it was he who first discussed the still unanswered question: 'What is a species?' It is true that he had no inkling of a genealogical basis for classification, but no one had in the seventeenth century.

Ray's fame has been to some extent overshadowed by that of his great successor Linnæus, but, as Dr. Raven says, "there can be no sort of doubt that Ray had the truer appreciation of the real task of a scientist". Linnæus had, in a superlative degree, the pigeon-hole type of mind. Had he lived in our times he would have been a great deviser of card-indexes and filing systems. He invented a method of 'running down' the species of plants which made botany a popular pastime with the dilettanti of the eighteenth century. His system of binomial nomenclature is still used for labelling our museums and herbaria, and no one has yet suggested a workable substitute; but in all that concerns the structure and life-processes of organisms he was far from showing Ray's knowledge or insight. Sachs' judgment that Linnæus "never made a single important discovery throwing light on the nature of the vegetable or animal world" will scarcely be disputed nowadays.

Hitherto it has been difficult to form any clear idea as to what manner of man this was whom Gilbert White called "Our countryman, the excellent Mr. Ray". He has been singularly unlucky in his biographers. His friend Dr. Derham, who wrote a sketch of his life and published his "Philosophical Letters" (selected from a much larger number now lost), intentionally omitted most personal details and concentrated on what he supposed to be of scientific importance; "of this", Dr. Raven drily remarks, "he was not always a good judge". Edwin Lankester, who edited Derham's "Life" and a further selection of letters for publication by the newly founded Ray Society, was ill-equipped for the task. The late Dr. R. W. T. Gunther, in the "Further Correspondence" published by the Society in 1928, brought to light a considerable number of unpublished letters and reduced to order much of the chaos created by previous editors, but did not try to tell a connected story.

Now at length we have a worthy biography, scholarly and sympathetic, which is not likely to be soon superseded as the standard authority on Ray's life. Dr. Raven, indeed, deplores that his lack of systematic training in biology disqualifies him from pronouncing judgment on Ray's position in the history of science, but it is not quite certain that this lack is matter for regret. He has escaped, at any rate, the myopia of the specialist and, on the other hand, he is, like Ray, an experienced and enthusiastic field-naturalist. "I have collected nearly all the plants, birds and insects that he records, and often in the same localities." Like Ray he can say "Divinity is my profession", and as a humanist he can appreciate Ray's "masterly" Latin, his interest in philology, and his pioneer work in the study of English dialects.

In all the mass of Ray's correspondence that has survived there are remarkably few references to his personal affairs. The letters are concerned almost exclusively with scientific matters and seldom reveal, even by accident, anything of the man himself. He had been corresponding with Edward Lhwyd for some ten years when the death of his little daughter Mary breaks down his habitual reserve. "You may possibly have heard, though I do not remember I ever told you, that I had four daughters." Dr. Raven points out that letter-writing of this impersonal kind was the means by which men of learning kept in touch with each other until "periodicals and meetings of learned societies superseded it and . . . means of communication made travel and talk easy".

Dr. Raven alludes to the "unpleasant controversy" that arose about a century ago as to Ray's share in the "Ornithology" of Francis Willughby which Ray edited and published after the death of his friend. The controversy was futile as well as unpleasant, for it is quite possible to regard Willughby as a pioneer ornithologist without deriding Ray as an "amiable and gentle" botanist. As Dr. Raven points out, there is ample evidence that Ray was "a scientist of genius" and Willughby "a brilliantly talented amateur".

In an eloquent tribute to Ray's "fascinating and heroic personality" Dr. Raven writes of him as "The