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Of nature trusts the Mind that builds for aye."—WORDSWORTH

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RESETTLEMENT OF POPULATIONS

IT is inevitable that some of the most pressing problems of the post-war world will centre around the question of redistribution of population, for this is not only at the root of matters of over-population and employment but concerns also the question of the place of minorities outside the national major consciousness in many areas. The problems will arise in Europe, in the tropical colonies, in South America, and in the great Dominions. While it is a mere truism to say that the globe still offers considerable areas of under-populated and scantily productive lands, it is obvious that the problem of shifting populations from one area to another involves far more cogent considerations than a mere study of numbers and population density.

The intricacies of the problem of redistributing populations are great and cannot be settled on a narrowly statistical basis. Following on a mere trickle, mainly of adventurers and unwilling deportees in earlier centuries, the nineteenth century was a period of free and unregulated flow of population from Western Europe to the poorly populated regions of North America, Australia, New Zealand, etc., and to a less extent from Mediterranean Europe to South America. The outward flow was actuated partly by economic failure at home, partly by political unrest, and most of all, perhaps, by the brighter hopes of prosperity born of the growing need of the industrialized lands to increase their food imports.

The need for exotic raw materials as well as the hope of establishing new markets for manufactured goods led also to the establishment of sovereign claims to almost all parts of intertropical Africa and other areas in low latitudes. These areas, unlike the temperate lands, afforded little or no outlet for European settlers but raised many thorny problems in control and utilization. The number of Europeans engaged in directing the native cultivator and urging him by one means or another to increased output is small; but the means of controlling these tropical areas and their local inhabitants has fomented serious problems in the redistribution of population and unfortunate interference with tribal life and native culture, to an extent scarcely compatible with high standards of either equity or wisdom. In Africa, outside the tropics, the white man finds land within the margin of his demand for progressive settlement; but the margin is often a fine one and is liable to be transgressed. Both in North and South Africa, the European has to compete with established races admirably suited to the environment.

Racially, this new dominion of the tropics did not involve the destruction of aboriginal inhabitants—as in most expansions to temperate lands—but rather a desire for increased native population to meet labour demands. The large-scale migration was not merely a European exodus. Later, but in a steady flow, the dense agricultural populations of the East sought more productive homes as Indians moved to East Africa and Malaya, Chinese to Malaya, Burma and Pacific islands, and Japanese to Hawaii and North America.

Attempts in the nineteenth century and earlier to transfer people from high to low latitudes met with little success, and the failure of the experiments was attributed to unsuitable climatic conditions. There were, however, other factors at work; and even in temperate lands the suitability of the climate was not the sole factor in promoting success or apparent success. The twentieth century saw a checking of the growing outward flow of population from Europe, largely due to legislative decisions of various States which affected even more drastically the coloured races. These restrictions were based mainly on economic grounds, but biological and political expediencies were not overlooked. The danger of lowering the high standard of living by the introduction of cheap coloured labour was no doubt as powerful a motive as the inability of the State to absorb into national unity so many alien racial elements, in closing the doors of North America and the Commonwealth of Australia to other than 'white' races. The lodgement of many Italians in the Argentine, and Swiss and Germans in southern Brazil, was in the first case due to political affinity of the Latin outlooks, and the second to political expediency in the avoidance of unsympathetic majorities in more obviously suitable lands. The danger of Brazil's experiment with Japanese colonists is a glaring example of lack of vision in this respect.

The experience of several countries has at least made clear the complexity of the problem, but the expediency of organized migration was never more pressing than it will be in the near future. If it be left to the dictates of political rivalry untempered by an appreciation of the many issues involved, little or no success can be anticipated. There are many aspects of the problem besides the political one. The physical factors for successful settlement are so obvious that they tend to obscure subtler considerations. Surface relief, soil, water supply, routes and transport facilities are clearly of importance. Ways of living, types of houses, clothing and diet, habits in which people are strongly conservative, are largely bound up with climate; but climatic influences resolve themselves largely into the amount of insolation, a function rather of latitude than of climate, and degree of relative humidity. Then again, many of the failures, formerly attributed to the climatic factor, to colonize or even effectively to dominate intertropical areas have been shown to be due to diseases, especially insect-borne diseases, and in measure as the insects can be destroyed or kept at a distance the threat of diseases disappears.

Another and totally different factor arises from the existence or not of the colour bar, coupled with the desire to avoid hybrid races. This feeling differs widely among migrating peoples and is strongest in those with least pigmentation. Another biological factor is of primary importance. There can be no true colonization unless the birth-rate remains high in relation to the death-rate. If the latter increases and the former decreases, the experiment of transferring population is doomed to failure. This important factor is impossible to predict, and seems to vary not only in regard to racial stocks but also in relation to the actual density of population. Some elements in a population seem to show a lowering of fecundity as density increases. Each land and each racial stock have their optimum densities. This optimum density is determined also by economic factors: the standard of living falls in an area where subsistence farming is carried too far, even though it may be temporarily relieved by industrialization. A potent biological consideration is the competition by widely divergent races. The attempts at Japanese expansion which have occurred during the past forty years is the chief example. Virtually all important outlets have been closed to them, and none will probably be open after the defeat of Japan in the present War. Japanese aims, and to a less extent Chinese aims, involve racial rivalry rather than intertribal competition.

There are, of course, many other economic factors involved, such as location in determining proximity to markets, and the relation of aboriginal to introduced labour. While above and beyond these considerations is the political one, which is concerned with avoidance of the national disunity that arises from the growth of small groups of traditions, cultures and languages distinct from the majority, and the resultant weakening of national consciousness. Considerations such as these are all of importance in deciding the uprooting and replanting of population. Varying weight must be given to the different considerations in every case. Within Europe, where the climatic factor may be less important, the economic and cultural ones are of greater weight. Acre for acre can never denote an equitable exchange, and no measure of even comparative stability can be obtained that does not envisage room for growth of population

The capacity of the land to bear increased population is of vital importance. Even before an area is fully utilized, impoverishment of value and decrease in productiveness nearly everywhere is a potential and often an actual threat. Somewhat tardily it has been recognized that every productive area has a limit to the demands that can be made on the land; and this limit is not merely one of soil fertility, important as that is, but is intimately bound up with rainfall and its fluctuations from year to year. Deserts advance through human folly rather than by change of climate.

There is another side to this large-scale migration, and that is the effect on the lands of origin. With the exacting demands of the States receiving emigrants as to good physical and moral stock, there is a drain of the best and an increasing pool of the weakest in the homeland. The wider world, where open to colonists, insists that no imperfect stock shall enter. Economically also, the drain, if confined either to agricultural or to industrial population, may have harmful effects on the home country in disturbing the balance between rural and urban life, and checking one or another aspect of production.

In his address as retiring president of the American Association for the Advancement of Science delivered at Ohio on September 11, part of which is printed on page 5 of this issue, Dr. Isaiah Bowman dealt with problems of this nature, and showed that the solution

can be found only by the scientific study of environments leading to an understanding of their capacity for population of different degrees of culture and economic development. In practice, most of the areas of settlement of high potential are marginal lands; this intensifies the problem, but makes more insistent a scientific survey of their capacity. Some lands will require considerable capital outlay before they can be regarded as satisfactory homes. The Soviet Union has found that to be true of its subarctic domain and has succeeded in implanting a considerable population in lands formerly regarded as useless.

This scientific study of environment is peculiarly the province of the geographer, who in correlating the complex functions of the many factors involved can give realism to the study of phenomena which in separate isolated studies are liable to become abstractions. A mere descriptive study will not suffice, nor will a purely analytic study help. There must be correlation between the exact physical factors and the variable human factors before any sure ground on which to base predictions is reached. The problems to be solved in transferring populations are concrete ones that need the illumination of the scientific outlook, and cannot equitably or with stability be solved on the grounds of mere political expediency. This applies both to the newer marginal lands and to the older populated lands, even if the weight of the various factors varies in different cases.

CONSTRUCTIVE DEMOCRACY

T V A

Democracy on the March. By David E. Lilienthal. (Penguin Special, S.151.) Pp. 208+15 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1944.) 9*d*.

The T.V.A.

Lessons for International Application. By Herman Finer. (Studies and Reports, Series B: Economic Conditions, No. 37.) Pp. viii+289. (Montreal: International Labour Office; London: P. S. King and Staples, Ltd., 1944.) 1.50 dollars; 6*s*.

THESE two books make an admirable supplement to the account of the Tennessee Valley Authority which Dr. Julian Huxley gave us last year. Their scope is sufficiently indicated by their sub-titles. In the first, Mr. David E. Lilienthal, chairman of the Tennessee Valley Authority, gives us from inside an interpretation of this great experiment in regional planning, as much from the point of view of its significance for the future as from that of narrating its technical and social achievements up to the present. This is the more popular of the two books. It is ably written and well documented, but endeavours to indicate the spirit rather than the technical detail of the achievements in the Tennessee Valley. Mr. Lilienthal is at pains to make plain the factors which have contributed to its success in the face of much strenuous opposition and misrepresentation.

The extent to which he has succeeded in this aim is indicated by the place which the book must assuredly take in the discussion of the machinery of democratic government. It is a major contribution to that debate on the relations between central, regional and local administration which must be faced in Great Britain if any effective solution is to be found to the problems of reconstruction, town- and country-planning and the location of industry. Mr. Lilienthal indicates at once the way in which the dilemma between planning and freedom may be resolved and in which fresh life may be brought into our democratic institutions by giving local interest and initiative more effective scope.

It is thus as a contribution to constructive thinking about planning, the demonstration that the regional planning of resources in conformity with broad national objectives and policies is possible, with full participation, through decentralization, of the people themselves, that the book has its greatest value. Technical achievements are only incidentally described, but Mr. Lilienthal has fully recognized that the experiment has involved solving the problem of the use of the technical expert in government, and that it is an experiment in government as well as in the development of national resources. His chapters on "Experts and the People", "Decentralization", "Regional Pillars of Decentralization" and "Modern Tools for a Modern Job" are not only lucid expositions of the way in which T.V.A. functions but also a contribution to the literature of scientific administration.

In his chapter "T V A and World Reconstruction", Mr. Lilienthal touches on the other factor which has given the Tennessee Valley Authority its general interest at the present time, and which is the main theme of Dr. Herman Finer's book. If this book is less well documented, it is more fully provided with statistical data, and the factual account of the Authority's achievements is more complete. The emphasis on the administrative machinery is similar: there is the same stress on the balance between a national plan, regional development and local co-operation, on the social as well as the technical objectives, and the establishment of the right relations between knowledge and power.

Five of the fourteen chapters of the book are in fact devoted to staff and administrative problems—the corporate agency and its methods of operation, management and personnel, Federal controls and State relationships, the employee relationship policy and labour, and employee welfare services, with which Dr. Finer has himself been more particularly concerned. Although much of this is relevant rather to American than to British conditions, and regard should be had to the fact that the United States, generally speaking, is a generation or two behind Great Britain in its labour policies, Dr. Finer argues with some reason that T.V.A's methods and experience indicate conclusively that public enterprise can attract to, and retain in, its service men and women who will work continuously with devotion and initiative. If they are given work, scientific or administrative, in office, laboratory or field, with a demonstrably high social value; if the work has meaning for them; and if there is security for the continuance of the service and of the livelihood it provides, they may be expected to serve with high, sustained, and increasing efficiency, free from undue envy and acquisitiveness. Nor are Dr. Finer's conditions wholly irrelevant to service in private as well as public enterprise.

The most important chapter in the book, however, is the concluding one, in which Dr. Finer discusses the problem of an international T.V.A. His examination of the functions and operation of the T.V.A. was undertaken, first, to record an experience valuable

to those generally interested in the possibilities and conduct of public development works, but more especially to distinguish the problems facing an international agency seeking to assist the development of the resources of under-developed countries. It is in this chapter that Dr. Finer gives us the full measure of his quality, and for this alone the book would be a major contribution to the literature of post-war international reconstruction. It is a sound corrective to whatever extravagance there may be in the expectations raised by the growth of public opinion vaguely favourable to the establishment of such agencies on the precedence of T.V.A.

No such model, Dr. Finer points out, can be regarded as suitable for adoption in every identical feature by other countries. T.V.A. is not transplantable without reservations and qualifications, but its characteristics help to bring out the problems and suggest alternative solutions. T.V.A., as Dr. Finer points out, was the answer to a complex of economic and social problems, which involved the relationship between a nation and one of its regions, poverty-stricken, but with resources capable of development. This lucid analysis clearly indicates the problems involved and the factors of which account has to be taken—the relation between the region and the national or world economy of which it is a part, the necessity of any country seeking international assistance first providing a comprehensive scheme of development, the financial problems, the importance of clear definition of scope of powers, the relation between development schemes and social progress, the importance of training both workers and managers. In his survey of problems of international assistance, Dr. Finer recognizes the room for "wide range of diversity", nor does his caution lead him to strike any the less confidently than Lilienthal or Huxley the note of hope.

The Tennessee Valley Authority has clearly shown the way democracy can march forward. The clear understanding of what is involved in that experiment and of the factors responsible for its success should at least assist in an apprehension in Great Britain of post-war problems of reconstruction and development, national and international, which will increase the prospects of the right measures and solutions being found and implemented. R. BRIGHTMAN.

ELLIPSOIDAL WAVES OR RELATIVITY?

Propagation Ellipsoïdale, Relativité, Quanta
Par H. Varcollier. Pp. iii+398. (Alger: Baconnier frères, 1942.) 20*s*.

"IT is the customary fate of new truths," said T. H. Huxley, "to begin as heresies and end as superstitions." In at least one large London college, relativity was for some time regarded as a heresy, or at best a kind of pure mathematics that had drifted out of touch with reality. Now we believe that relativity is the only theory that can explain certain experimental results. This belief is mere superstition unless we are prepared to examine alternative explanations, such as that offered by M. Varcollier.

In an earlier book, "La Relativité dégagée d'hypothèses métaphysiques" (1925), he claimed that there were several hypotheses which could explain the Michelson-Morley experiment without abandoning classical ideas of space and time. He has now worked out in considerable detail the consequences of one of these hypotheses, namely, that the wave front due to a source moving in a straight line with velocity v is a prolate ellipsoid the centre and forward focus of which are respectively at the initial and instantaneous positions of the source. In other words, the wave front differs from the usual sphere of radius ct in that the diameters perpendicular to v are contracted in the ratio $\sqrt{(1 - v^2/c^2)} : 1$. This makes no appreciable difference to the common phenomena of optics, for both hypotheses give the same velocity in the direction of motion, and the normal velocities are in the ratio given above, which for ordinary values of v is hard to distinguish from equality.

Several chapters are devoted to the mathematical development of what we may call the "ellipsoidal theory", and many of the results differ only slightly, if at all, from the corresponding results of relativity. In particular, we find a complete analogue to the Lorentz transformation. The climax is the 'ellipsoidal' explanation of experiments which are usually cited in support of relativity. Although M. Varcollier's theory is not compatible with the relativity postulate of the *universal* constancy of the velocity of light, he obtains a constant total time for the double journey of a ray such as occurs in the Michelson-Morley experiment. He is equally successful with another negative experiment, that of Trouton and Noble. Coming to the positive experiment of Döppler-Fizeau, with a law for the composition of velocities which, to a high degree of approximation, is the same as that of relativity, M. Varcollier gets an approximately equal result. In the case of Sagnac's experiment, so embarrassing for the whole-hearted believer in the relativity of rotation, in which light travels in opposite directions round the circumference of a rotating disk, M. Varcollier obtains the well-known formula, confirmed by experiment, for the displacement of the interference fringes. This arises naturally from his idea of absolute space; he is scrupulous in pointing out that in this case the 'ellipsoidal' hypothesis is not essential, as a spherical wave front would give the same result.

So far the author has done very well; but it is surprising to find no reference to the eclipse results, the advance of the perihelion of Mercury, or the spectral shift of light from the sun. Yet it was these three pieces of evidence, or at any rate the first two of them, which were chiefly responsible for raising relativity from a heresy to an orthodox tenet

There is a final chapter (Chapter 9) which it is not fair to criticize in detail, as it is avowedly only a sketch of possible extensions of the preceding principles. It contains, among many other things, a new theory of the motion of an electric particle, with remarks on nuclear magnetism, the proton, the neutron, and the Bohr magneton. There is also a new quantum mechanics, in which it is emissive orbits that are quantized, a breach with the accepted theory that is explicitly acknowledged. However, Planck's constant and Sommerfeld's equation reappear unchanged, and the fundamental Rydberg-Bohr spectral formula is not much changed.

Whatever may be thought of M. Varcollier's results, we can all admire the courage which sustained him, in the darkest hour of his country's history, to continue his researches and to complete them for publication in Algiers, far from the facilities of Metropolitan France. H. T. H. PIAGGIO.

LAND SETTLEMENT AND RESOURCE DEVELOPMENT*

By DR. ISAIAH BOWMAN
President of the Johns Hopkins University

Choice of Essentials

IT may be assumed that well-organized peoples work within the limits of more or less deliberate choices of essentials as modified by the accidental and the unpredictable. To-day the people of the United States insist on a high standard of living as one choice among a number of essentials, because access to the world's wealth, or the power to create it, are now taken for granted, thanks chiefly to geographical discovery, the inventions that have grown out of modern physics and chemistry and the crop changes due to plant introductions and plant breeding. In Britain, the post-war standard of living has at times seemed as important as the War itself. Housing now has first priority in post-war plans, civilian supplies second, and manufacture for overseas trade third. It is held that the War will not seem won to the returning soldiers if decent places to live in are not assured.

How to marshal our forces in support of the great ideas we intend to live by has now become one great essential. Resource development is tributary to that. We cannot lay out the lands and dominions of the world and disinterestedly observe where and how development should proceed to give us a rational scheme. We are not free in this respect. Our fate is now bound to other lands far and near. There is no such thing as 'pulling out' of a world war or the peace that follows it. The fine net of world circumstance entangles us all. This is the political context of land settlement and resource development from now on.

If this reasoning be sound, we must look at marginal lands not as permitting, but rather as compelling, action. Some of the largest tracts are in the British Empire. Canada and Australia have too few people, considering the territory they embrace and its strategic value. It is urgent business to fill these under-developed lands. The population structure of the British Isles is such that a decline is forecast to thirty-two millions by 1976 (Carr-Saunders). Half the assumed rate is alarming enough. A general overseas movement from Britain to the distant Dominions is therefore out of the question. Where shall the non-British migrants be found who will most readily people the Dominions? In Europe certainly, but this clearly means the designation of desirable stocks, encouraged migration and a certain measure of accelerated nationalization. The last-named is necessary for purposes of unity (through education) in essentials of community life, and for the political cohesion that self-protection demands. If migrants are without education in the history and traditions of the country to which they migrate, or the capacity to benefit by them, they may weaken a nation in a period when cohesion and strength are matters of life and death.

If there is agreement on these essentials, we must aid the settler in choosing the best lands for given crops, the best cultivation techniques for quality and the best market conditions, as well as the limits of production in relation to price levels. The virility and imagination which Mackinder invoked on Britain's behalf in 1902 as he looked at the perilous facts of British geography, demography and power, are now most urgently required by all of us. The insularity of the British Isles is only different in degree from that which marks the present situation of the United States. Our great strength is sustained in part by drawing upon a wide range of foreign products. Any human stock that has staked out its portion of earth as the home of free institutions must now effectively occupy and defend what it claims. Having chosen a course, every support that science, sense and experience can bring should be marshalled to people the best remaining lands with assimilable stocks capable of making a sound choice of essentials.

The word 'assimilable' is important. Political unity is short-lived unless continuously nourished. Land settlement in the post-war period starts with people. Land is secondary. We cannot create a special citizenship bound to the land. Only the serf and the bondsman are so restrained. It is alleged that the only Venezuelan agricultural colony settled by immigrants since the colonial era that has survived to the present time is Colonia Tovar. It is in the coastal Cordillera, twenty-two miles from La Victoria, and was founded by Codazzi a hundred years ago. W. D. Rasmussen concludes that its unique success is a reminder to Venezuela "that it would not be advantageous to have the Nation's unused land settled by isolated frontiersmen on a subsistence level or by nationalistic groups. Social and economic integration are essential"[1].

The integrating powers of States differ as much as their physiography and economic life, education, sports, speed and volume of circulation of newspaper and mails, and all the other attributes of culture differing so widely. That is why a world-imposed theoretical plan of settlement would most certainly fail, whereas national programmes inspired by disinterested local studies of a scientific nature may succeed.

Over-all Conditions: A Basis of Judgment

If the limits of land settlement are to be drawn strictly on the basis of immediate economic returns, there will be no general venturing. Success demands an immense excitement about settlement, but an excitement controlled by a choice of essentials, the social context, the scientific findings, the deliberate choice of things it is meant to do and pay for, whether they are economic or not. Sound conclusions as to what is or is not economic in pioneering are few in number. Medical science has a good word for the assemblage of over-all conditions upon which a judgment must be based. The word is 'syndrome'. It is defined as 'a group of signs and symptoms that occur together and characterize a disease'. Fever is the accompaniment of many diseases. The same is true of pain. But one diagnoses a given case by the things that occur uniquely together.

This 'occurring together' is characteristic of each type of marginal land. It is worse than useless, it is misleading, to say that the average rainfall of a certain area is sufficient to support good crops four years out of five and therefore it is safe to engage in wheat and barley cultivation or cotton or corn. The interpretation of rainfall in terms of crops is but one

* Portion of the address of the retiring president of the American Association for the Advancement of Science, entitled "Commanding Our Wealth", delivered at Ohio on September 11 and published in full in *Science* of September 15.

factor in an extremely complex set of circumstances.

Each crop and each method of cultivation must be studied in relation to each soil type, each vegetation type, each rainfall type, each slope gradient, in combinations that must be analysed fundamentally and not in the light of a particular political thesis. Good objects from one point of view may be achieved at the expense of other equally good objects.

"The station holder [of New Zealand] most 'efficient' in the eyes of his neighbors . . . (in that he frees his hill country of weeds) is often the first to be driven off his holding by advanced erosion. Soil losses are widespread and serious and it is evident that remedies successfully employed in the United States can not be used in New Zealand without considerable modification. In individual regions the problem is unique: each region will require its own solution. The immediate and urgent need is for research and experiment. Effective soil conservation implies the kind of use and treatment of land that exactly fits its capabilities and needs"[2].

The example of tsetse fly control illustrates a conflict of purposes and results that can only be resolved by intensified scientific studies. Each of the twenty-one species of fly has different habits and different requirements as regards vegetational habitat. These differences bring each species in contact with different combinations of food animals. Each species also has a range of habitats.

"Hence the subject resembles the song of the 'Ten Little Nigger Boys'. As you find the solution for one type of country, nine types remain, and so on. But we are finding one thing in common for all the tsetses; each requires more than one vegetational type at a time, and the types it requires must be in contact with one another to support it in all seasons and years. We call this 'concurrence of requirements'. *Glossina morsitans*, for instance, needs savanna wooding to rest and breed in, and vleis to search for food in. Continuous uniform savanna wooding will not support it, while ant-heaps with heavy vegetation, near or at the contact of this and the vleis, add much to the suitability of the general vegetational concurrence. This simplifies the problem very greatly. It means that you need eliminate, by planting or otherwise, only one requirement of the tsetse at one season of the year—or (it may even be) of an exceptional year—in order to eliminate the tsetse"[3].

Conflict of purpose is underscored in the final report of the Drought Investigation Commission of the Union of South Africa (1923). The destruction of the natural vegetation increased soil erosion while decreasing the underground water-supply, thus making more difficult the watering of stock. Complaints having been made by farmers that the planting of catchment-areas in South Africa with fast-growing conifers and eucalypts has diminished the dry season water-supply in certain streams, a special committee of the Fourth British Empire Conference in 1935 considered the problem. In view of contrary evidence and the concurrence of a period of diminished rainfall, the complaints were discounted; nonetheless the committee pointed out the desirability of a comprehensive scientific investigation into the effects of tree-planting on local water-supplies. The lack of scientific knowledge through controlled experimentation could only be made up by precautionary advice. Quoting again from "Colonial Forest Administration":

"In the meantime, in order to allay public anxiety, it was suggested that where water conservation was a vital matter, fast-growing exotics should not be planted at the actual sources of streams and the eyes of springs, where, however, the natural vegetation should be carefully protected. There has never been any question as to the value of the indigenous forest as a means of conserving and regulating the water-supply".

The limited application of scientific results from a single area is a truth that drives home the need for intensive studies, area by area. The combination of controls, risks and needs is often unique. The warning is given that:

"Because the white farmers on the karroo sediments of the Cape Colony, or on the dolomites of the western Transvaal have been saved by an energetic policy of providing bore-hole water with the aid of 'forests of windmills', a similar policy will not necessarily help nomadic Masai or semi-nomadic Sukuma on the old metamorphosed schists or granites of Tanganyika Territory. In Tanganyika Territory, as elsewhere, the layman is apt to shout for irrigation schemes without knowledge of their implications. Only recently one read in *The Tanganyika Standard* . . . the following statement . . . 'Vast areas in the Territory are entirely waterless. This can be altered by a series of canals from which irrigation streams could be made'. It all sounds so wonderfully simple and straightforward! Matters with regard to first cost, salinity and lack of suitable soils become even worse in those parts of the territory where, in the absence of perennial rivers, irrigation of the reservoir type would have to be resorted to. One is, therefore, forced to the conclusion that large-scale irrigation schemes should be left severely alone and that in the light of a recent fuller understanding of the complications of climate, soils, hydrography and markets the early optimism of the Germans regarding the possibilities of such schemes can no longer be upheld"[4].

Brazilian and Peruvian Examples

A useful contrast has been drawn by M. L. Cooke, in "Multiple Purpose Rivers"[5], between the São Francisco River in Brazil and the Amazon, the Amazon being limited by the fact that it is not a 'multiple-purpose' stream. Throughout its course in the lowlands there is no opportunity for electrical development and no proved coal deposits. By contrast the São Francisco Valley has a good alluvial floor, irrigable acreage "as much as that of cultivated Egypt", and good sites for dams and power plants that would extend water control and power development and provide the manifold services and opportunities that now make the valley "socially inert for lack of a plan".

Social inertia has many facets. Is its source in diet, or the extent of the tradition that manual work signifies reduced status? Or is it due to the prevalence of malaria and dysentery? Is a bad transport system contributory? The settlers from Ceará, a region of recurrent droughts, plus others from Rio Grande del Norte, Paraíba, Pernambuco and Alagoas, represent a new migration drift through the São Francisco Valley[6]; 160,000 left Bahia for São Paulo between 1936 and 1942, a large number from the valley itself. From the port of Joazeiro the bulk of the migration tide moves upstream by riverboat. Permanent settlement in the valley, despite the tide of potential

settlers, is scant and the population density remains low because of the inflexible pastoral pattern and the semi-aridity.

The slightest increase in population is apt to upset the delicate balance between population and resources which has been achieved as a result of the natural ebb and flow of humanity over a period of centuries, "and may easily strain beyond the limits of elasticity the carrying capacity of existing wells or pools, natural or artificial. Not until the vise-like grip of the present extensive economy is broken and the use of the water rationalized, can there be sufficient progress in the valley to make possible an increase in population".

The settlement possibilities of the Amazon have always stirred the imagination of travellers, sometimes for and more often against intensified occupation. Some overlook the profound handicaps of isolated settlements as set forth in a useful medical survey by M. H. Kuczynski Godard[7], of the selva of the Rio Perené in Perú, with a chapter on Amazonian colonization in general. No report shows more clearly the necessity for writing the terms of settlement of the Amazon Basin and its borders in their social context rather than in terms of the imagined possible. It is immensely costly to give modern medical services to settlements so widely dispersed, and health conditions are in general deplorable. Godard emphasizes the desire of enterprising persons to leave the region for more comfortable and more sanitary places, a negative migration which steadily drains off the best. There results a tendency on the part of white settlers to remain stationary, primitive, morbid, hopeless. This brutal land is a sign of God's power, wrote Bustos, in the purple terms of the romantics. If we say that the Indian has adapted himself to it, the answer is given that to master his environment he has spent all his energy and has done nothing more. He exists without change. His religion is magic, and tradition and fear perpetuate it. For the whites, education, medical services, and enterprise through outside aid are prescribed. Government recoils at the expense. It is held that there are safer and more comfortable places for enterprise.

The border of the Amazon basin may one day display a different aspect. That border is an empire in itself. It has the climatic and vegetative diversities of varying altitudes. It has access to the highlands on the west in Bolivia, Perú, Ecuador and Colombia. It is the exception to the gospel of land scarcity in Perú, as set forth recently by R. A. Ferrero[8]. Relaxation from the continued high temperatures and relentless humidity can be found most readily by locating settlements near the upland mountain borders of the basin and at moderate altitudes. Local air conditioning in the lowland plains will give temporary relief; but it is no substitute for a change of scene and climate.

Of social life in the pioneer zones of Brazil, in general, James writes that "the 1938 immigration decree requires that each colony established in the pioneer zones must have at least 30 per cent of people born in Brazil, and not more than 25 per cent may be composed of foreign people of any one nationality". In the rural schools part-time instruction must be given in Portuguese, and Brazilians must direct the schools.

"The possibilities of settlement in the pioneer zones of Brazil cannot be understood or predicted from a study of the physical quality of the land alone . . . the kind of people who may desire to undertake the settlement of Brazil's pioneer zones can not at present be identified, nor can we know what political and social ideas or what technical abilities they will bring with them. Beyond a program of mapping, analysis of the physical quality of the land, interpretation of the present patterns of settlement and of past experience on different kinds of land, the prediction of future population capacity involves too many unknown factors to be profitable"[9].

Meanwhile the problem becomes more and more pressing: "Brazilians have become increasingly worried over the doctrine that vacant land is the patrimony of mankind and should not be allowed to remain idle while millions of humans live on a low standard because of lack of sufficient land. . . . The millions of acres of absolutely unused lands in Brazil, the failure to develop the rich deposits of iron, manganese and other minerals caused a natural uneasiness, a recognition that weak nations have always been absorbed by strong ones, that as Bismarck once remarked, natural riches in the hands of those who do not know how to develop them, nor care to do so, are a permanent danger to the possessor. . . ."[10].

Regional Framework of Settlement

The problem of future migration and settlement is complicated by runaway population-growth in a few countries and the demand that other countries make room for the excess no matter at what cost to social and political cohesion and living standards. Here politics, religion and national ambition are joined fatefully. There can be only further trouble in the international field if we assume that the subject is one so delicate in politics and religion that it may not be talked about. It is equally dangerous to follow the course advocated during the past few years and deny the importance of national boundaries, as if one could change them freely to suit the changing demographic conditions of the world and let populations stream out in every direction at will. Such a policy of progressive revision would be an invitation to constant emotional pressures, to ingenious inventions of argument, to the destruction of treaties by violence, to the undoing of every form of international co-operation.

The possibilities of greater concentration of population in the already densely peopled industrial regions has been emphasized during the past twenty-five years. Primary production requires no forced expansion of settled areas, so long as technology supplies new avenues for investment and employment and corresponding concentration to suit the expanding tastes and diversified needs that technology has already stimulated. As new industries make new demands upon primary production in overseas lands, especially in tropical areas, both the income standards and the demand for manufactured goods will be raised.

"The unemployed in European industrial areas would then find employment at home in producing the things exported to tropical countries. . . . The need for emigration decreases with the opening up of such opportunities at home, and as this process is both theoretically in accord with the tertiary stage of industrial development, and has already been occurring on a large scale in practice, we must infer that centripetal movements of population are likely to be more important than centrifugal in future. In a reasonable world the European is likely to benefit most by the elaboration of his skill in his own land.

Given a relaxation of economic barriers, 'Europe is perhaps of all parts of the world the best suited to support a larger population'. If this dictum seems surprising it is only because we have fallen into the error of confusing high density of population with population pressure"[11].

The theory has been advanced and merits close examination "that differences in density were not causes but rather results of migration, that the basic cause of migration lay in differences in standards of living not necessarily correlated with density of population". An Italian example illustrates the point. The greatest increase in the rate of emigration during 1876–1925, concludes Forsyth, was in sparsely peopled agricultural districts, "a fact showing 'the falsity of the prevalent opinion that there is a direct relation between emigration and density; in fact no such relation appears and in many cases the reverse relation is found' ".

The mounting scale of home investment in all countries is emphasized by many analysts; likewise the requirement, in overseas agricultural settlement on any large scale, of very great capital sums. "If a country complaining of surplus population could find these sums, it would do much better to consider first whether the money could not be better used at home in stimulating industry so as to furnish employment and raise domestic standards, permitting meanwhile such emigration as could take place without public assistance"[12].

Migration and Boundary Stability

To change national boundaries capriciously would be the highest folly, in my opinion. We cannot undo two hundred years of history by light-hearted talk about the rearrangement of the populations of the world, as if densities could or should be smoothed out. To attempt to do this would at once bring into fatal conjunction differences in food habits, in standards of family life, in that virility and choice of essentials that are required successfully to defend one's own against robbery by war, and in all the other things that we label culture or purpose or ideals. Populations are not mere aggregates of numbers densely peopling the earth here and lightly peopling it there. We must look at the moving spirit of each aggregate. If purposes and ideals disappear, then we are mere livestock and our fate does not matter. It is the ideal toward which we strive that gives our national life a purpose. All these things confront us when we think responsibly about changes in national boundaries. We cannot overlook the importance of property lines, legal administration, taxation and all the other attributes, powers and responsibilities that go with political and purposeful control of specified territories. The nations will certainly not mingle land titles and effects, any more than they will mingle codes and culture systems, or water them down to some common scheme that means nothing to anybody.

To be specific, free migration and elimination of boundary restraints would not solve any identifiable problem of distributing the annual increment of five millions of Indians in other countries. It would only weaken, confuse and distress the rest of the world. Whatever outside responsibility there may be, the Indians also must do something at home about that increment. As for outside responsibility, consider the shipping required to transport overseas five millions, or even one million a year. Consider the social services required to establish them in new places. Consider the communities that they would form of unlike peoples with ideals, historic backgrounds, culture systems, family life, religion, etc., so unlike their neighbours in their new environment. Further, there would be neighbours almost everywhere. A million Indians cannot be dumped into the Amazon basin in a given year or in five years, for the supply of social services is at a minimum there and adequate services cannot be improvised: they require time for seasoning through experimentation. Power, humanely exercised, has the responsibility of saying how it would absorb what that number of settlers would produce from a forested and savanna terrain. Brazil has the responsibility of saying whether she desires an Indian empire in the Amazon, were one possible of creation. Whether we assume its divisive political influence or its economic and social failure, the problem would be on Brazil's shoulders if she ever attempted so bizarre a social enterprise as wholesale settlement of immigrant Indians in Amazonia. Social and political cohesion worries Brazilian leaders now: they are not likely to invite an enlargement of the area of difficulty.

The nature of some of the problems that arise when two cultures are placed side by side may be inferred from the experience of Fiji. In 1940 nearly half the population was Indian (98,000 out of 220,000).

"Indians have picked out many pieces of good land near native villages and leased them, and the improvident Fijian has been compelled to carry on his agricultural methods on poorer land farther away from his native community. . . . The 'use' of land in the mind of a native is not confined to his need for an area large enough for growing foodstuffs. He desires to retain freedom to search for wild food, for materials for building houses, and to hunt for wild pigs. . . . Young Indians assert: 'There are thousands of acres in Fiji not being used. We are British subjects and we want some. We were born and reared here'. . . . The question of landownership and land use is not only important to those who own the lands but is also of vital importance to the Indians who have made their homes in Fiji. Bound up with it is the future welfare of the colony. Native chiefs passed a resolution in 1936, asking, in effect, that the government should control for them all the lands they did not require"[13].

We have already noted inequalities of population density, opportunities, standards of living and political ideals that are bound up with questions of migration and settlement. Behind these inequalities is a conflict of philosophies. In the world of the future a balance of ideas as well as a balance of power may have to be reckoned with. Some students believe that industrialization will start, or at least accelerate, the desired cycle of conditions that lead to reduced birth-rates. Others contend that this will endanger the world's peace by placing greater power in the hands of politically immature peoples.

In a broken world, migration on a large scale is not politically feasible. Employment is an intense preoccupation for the city-half of our population. The War has taught us the crucial need for internal unity. The risk of turbulence implied by the wholesale shifting of populations is shunned by every country. The occupation of the remaining lands, a highly desirable end, thus becomes an outward growth from established bases, with science and government sharing the task, the factors of time and personal initiative being taken into account.

Scale as a Factor

The sense of enterprise which permeates successful settlement endeavour depends nowadays upon well-selected sites and a certain scale. Population centres of 3,000–5,000 are required, as well as smaller centres and individual farms, if the varied services that make new homes acceptable are to be supplied. To develop smaller towns or isolated villages of a few hundred, or to go back to lone pioneering, is to call for too great a change in the way of life of present-day settlers. The larger size will also have a conspicuous effect in drawing population from nearby well-settled areas where there may be less opportunity for land development. It is the extension of settlement from already established localities that provides the bulk of the population of pioneer groups. The Inter-Departmental Committee on Migration Policy, reporting in 1934, has a significant statement on the matter from the particular point of view of British overseas settlement.

". . . We find it very difficult to believe that organized group settlement could deal with, at the most, more than 2,500 families—say, 10,000 souls—in a year; neither the localities, nor the capital, nor the administrative capacity for anything in excess of this—or perhaps for anything as large as this—are available. There are, however, no limits, other than the absorptive capacity of the Empire overseas, to the magnitude of the stream of migration which may be produced by the other method. [The prospective settler migrating with his family on his own initiative or that of a friend or relative.] It was by this method that, in the ten years immediately preceding the war, over 148,000 migrants annually left the United Kingdom and settled in the overseas parts of the Empire. In the ten years 1919–1928, the annual average migration produced by this method was over 132,000. We are convinced that it will be by this method, individualistic, and therefore congenial to our national bent, that the great bulk of migration from this country will always take place. . . ."

The extremely important point is made that schemes for settling thousands of families overseas in new communities tend to impress the public by the magnitude of the organization involved, the sums expended and the new names of towns on the map. The bustle and publicity of ship chartering, port building, road construction, co-operative buying and selling and the selection of a balanced population containing the right number of farmers, tradesmen, professional men—all these activities create a stir and excitement that are alleged to have no corresponding practical results when it comes to the real business of counting new settlers and appraising their staying power on the land. But it would be more correct to say that the excitement is out of proportion to the results, thus recognizing the possible value of excitement.

The two methods are not mutually exclusive. The bulk of the lands available for settlement, out of a world total of perhaps three million square miles, can be occupied by self-initiating settlers. There are some areas, however, that require substantial capital investments if success is to be attained. Government will be called on to take the risk of supplying such capital if the objectives include national security or other non-economic ends. We all remember the wide and sustained public interest in the irrigation projects of the U.S. Reclamation Service following the turn of the century. "Homes for Millions" became a popular slogan. Yet when the twenty-four national irrigation projects had reached the point of substantial development in 1926, there was a total farm population upon them of only 137,000. By contrast, in the two decades preceding, motivated by individual enterprise, there were more than 600,000 final entries under the Homestead Act, in addition to coal-land and desert-land entries.

What the Reclamation Service did was important and desirable. It undertook the large capital-venturing beyond the means of the individual farmer or the small group. Were such capital-venturing to be undertaken for petroleum exploration in Alaska, for example, in parallel with advanced agricultural experimentation, it is possible that the struggling settlements of the pioneer fringe of Alaska would take on a new lease of life and that the enlarged scale of operations would create the excitements and sustain the hopes that are necessary for permanent occupation. But in the end it would be the push, virility and enterprise of individuals that would constitute the final test of staying power and attachment.

Contrasts in National Inventories

The contrast between east and west, about migration and land, in part grows out of our different purposes in using it. Land in China is for subsistence; land is food. In the United States land is one factor in the complicated problem of (1) keeping up a standard of living on the land so as not to sink farmers to the level of peasants; (2) balancing the benefits of total production, city and country, through the intricate mechanisms of an industrial society.

We do not bring all our land into full production because we already have a surplus production. (I will not venture into the tangled question as to whether or not this is only a commercial and not a social surplus.) By contrast, land division in India and China has been carried so far, under growing population pressures, that tens of millions are at starvation-level. The problem facing Governments is how to ease these conditions before Australia becomes an adjunct of India or China. Economic easement in China seems a far more rational solution than merely keeping Chinese out of Australia. If white settlement in Australia is urgent, it is equally urgent to begin the industrialization of China. The balance of ideas and opportunity may thus become a sufficient substitute for the balance of power.

There seems to be a high correlation between prosperity in new lands and migration to them. Historically, that prosperity has been in turn dependent upon the power of industrial centres to buy the raw materials of the producers of the newer lands. If the post-war world enters an era of expansion (to supply the losses of war and delayed consumption demands), there seems to be a clear possibility that the former relation of industrial areas to raw material areas may be substantially regained. The act of industrialization of former raw materials areas in itself will augment the relative prosperity of the latter. There is no reason, therefore, why further settlement and industrialization may not go hand in hand.

Goals of National Policy

As a general working principle, the acceptance of a bare subsistence standard for planned pioneer settlement may be condemned as a national policy, whether in Australia or Brazil. But settlers on their own initiative will also be looking for small doors of

limited opportunity, not necessarily a gateway to the best the world affords. This may prove true of refugee settlement in particular. For refugees, a higher degree of tolerance of hard conditions has been assumed. Will it work out that way ?

A scientific inquiry in each major area proposed for settlement cannot stop short of the goal of acceptable livings. Granted that there must be wide tolerance at first on the part of almost all settlers, can an inventory of resources, area by area, assure them diversified production and enlargement of opportunity with endurably brief delay ? Since most areas of potential settlement are marginal, can scientific inquiry reduce the risks ? One may be sure that vast sums will not be spent in the post-war years upon doles to settlers who are badly located. There is every reason, however, why initial aid should be given to well-placed units who will add to the resources and taxable wealth of the countries of their adoption.

The abundance of unused land strikes every observer, yet it is the scarcity of commercially valuable unused land that intensifies the problem. The scientific study of settlement has become to a large degree a study of unused land. What keeps it out of production ? Is the soil deficient ? Is the water supply undependable ? Are the required cultivation techniques peculiar ? What is the natural unbalance that must be corrected by scientific study and treatment ? The tsetse fly, natural versus artificial vegetation, extreme price changes and soil erosion are among the examples we have mentioned.

No less important is a study in national psychologies. What is the attitude, country by country, toward the foreigner ? What part in the shaping or retention of a recognized national attitude is played by experience with groups already established ? Are the examples of Colonia Tovar, Cyrenaica and São Francisco correctly interpreted ? What is the peculiar nature of the essential political processes in each country ? How do the variant political processes play upon or determine migration policies ? What are the specific economic equivalents of migration in industry and trade ?

When the answers to these and other questions are given, not in the terms of a single specialty, but in the terms of a social and political mosaic, country by country, the science of settlement will have reached maturity. Sophistication of the investigator plays a part in finding practical answers : he must have that "nice tact of circumstances" which enables him to determine reasonably well what specific groups of men can do, or will do, or may be persuaded to do.

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SCIENTIFIC CENTENARIES IN 1945

By ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

A REVIEW of the scientific centenaries which will occur in 1945 may well begin with a quotation from the autobiographical notes of the English mathematician John Wallis (1616–1703), written when he was eighty : "About the year 1645," he wrote, "while I lived in London . . . I had the opportunity of being acquainted with divers worthy persons, inquisitive into natural philosophy, and other parts of human learning ; and particularly of what hath been called the *New Philosophy*, or *Experimental Philosophy*. We did by agreements, divers of us, meet weekly in London on a certain day, to treat and discourse of such affairs. . . . These meetings we held sometimes at *Dr. Goddard's* lodgings in *Wood Street* . . . on occasion of his keeping an operator in his house for grinding lenses for telescopes and microscopes ; sometimes at a convenient place in *Cheapside*, and sometimes at *Gresham College*, or some place near adjoyning.

"Our business was (precluding matters of theology and state-affairs) to discourse and consider of *Philosophical Enquiries*, and such as related thereunto : as *Physick*, *Anatomy*, *Geometry*, *Astronomy*, *Navigation*, *Staticks*, *Magneticks*, *Chymicks*, *Mechanicks*, *and* natural *Experiments* ; with the state of those studies, as then cultivated at home and abroad. . . ."

From those gatherings and others at Oxford sprang the Royal Society, the first official record of which is a memorandum relating to a meeting on Nov. 28, 1660, held in Gresham College. "W. G." wrote :

> "At Gresham College a learned knott,
> Unparallel'd designs have lay'd
> To make themselves a corporation
> And know all things by demonstration."

Of the various subjects Wallis named, "Chymicks" was one which perhaps most needed the experimentalist to remove it from the realm of mystery. Jean Rey, a Frenchman, appears to have been such a man. He was born in what is now the Department of Dordogne ; he studied medicine, corresponded with learned men and worked at practical chemistry. His death took place three hundred years ago, but in 1630, fifteen years before he died, he published "Essays de Jean Rey sur la Recerche de la cause pour laquelle l'Estain et le Plomb augmentent de poids quand on les calcine", which was thought worthy of republishing in 1908 and was reviewed in *Nature* of July 9, 1908. This memoir appears to anticipate the discoveries and views of Lavoisier by nearly a century and a half, but A. N. Meldrum (*Nature*, July 30, 1908) states that there is little evidence that Rey made experiments of any value in support of his views.

The year in which Rey died, his countryman Nicolas Lèmery (1645–1715) was born at Rouen. He lectured in Paris, spent some time in England as a Protestant refugee, but having embraced Catholicism, returned to France and was given a seat in the Royal Academy of Sciences. To-day he is remembered for his "Cours de chimie" (1675), which went through many editions and was translated into several languages. "The fine imaginations of other philosophers", he wrote, "concerning their physical principles may elevate the spirit by their grand ideas,

but they prove nothing demonstratively. And, as chemistry is a science of observation, it can only be based on what is palpable and demonstrative." The year 1645 has sometimes been given as the birth year of the English chemist John Mayow, but as Dr. Douglas McKie has shown, he was baptised in Morval Church, Cornwall, on December 21, 1641.

Passing to 1745, we have the births of Gahn, the Swedish chemist, of Etienne Montgolfier, the younger of the two pioneers of ballooning, of Schröter, whom Miss Clerke referred to as "the Herschel of Germany", and of the much more famous Volta. Johan Gottlieb Gahn was a student under Bergmann, a contemporary of Scheele and an associate of Berzelius. He was a chemist before he was a mineralogist, and a mineralogist before he became a metallurgist. Expert with the blowpipe, he was the first to isolate manganese. Montgolfier, too, was a chemist, as well as being a papermaker, and it was reading Priestley's memoirs which gave him some of his ideas. The monument erected at Annonay in 1883 honours both brothers, and was erected to commemorate the centenary of their first full-scale experiment with a '*machine aërostatique*'.

Johann Hieronymus Schröter (1745–1816) was a worthy representative of that great band of amateurs who have furthered the cause of astronomy. Born at Erfurt, he became a law student at Göttingen and knew Herschel's musical family at Hanover. When thirty-three he was made magistrate at Lilienthal near Bremen, and there in his spare time studied the moon and planets. It was Schröter's assistant, K. L. Harding (1775–1834), who discovered the minor planet Juno, and when Harding went to Göttingen his place was taken by the young supercargo, Friedrich Wilhelm Bessel. Early in 1813, Bremen was occupied by the French, and in April Schröter saw his observatory pillaged and his books and writings burnt. He died three years later, a broken man. Though Volta, too, lived through the whole of the Napoleonic Wars, he suffered no such catastrophe. He was born at Como on February 18, 1745, and there he died in 1827. In 1899 and again in 1927, great international gatherings of scientific men were held at Como to mark the centenary of his most important discovery and the centenary of his death. Among Great Britain's representatives at the second meeting were Sir J. J. Thomson, Lord Rutherford and Sir Arthur Eddington.

Of the men of science who died a hundred years ago, few were better known than John Frederick Daniell, who expired suddenly on March 13, at a Council meeting of the Royal Society, of which he was at the time the foreign secretary. London born and bred, and educated privately, his devotion to science led to his admission to the Royal Society at the age of twenty-three. He worked with W. T. Brande, and on the establishment of King's College, London, was appointed to the chair of chemistry. The invention of the Daniell cell brought him the Copley Medal of the Royal Society. While Daniell was busy with his electrical experiments, the retired French watchmaker Jean Charles Athanase Peltier was engaged in much the same pursuits, discovering in 1834 the Peltier effect, the reverse of that made known thirteen years earlier by Seebeck. Peltier was born in 1785 and died on October 27, 1845. Nine days before this, the last of the Italian-French family of astronomers, Jacques Dominique Cassini, died at the age of ninety-seven. His father, Cesar François, had died in 1784 when seventy, his grandfather Jacques in 1756 when seventy-nine and his great-grandfather Jean Dominique in 1712 at the age of eighty-seven. For a hundred and twenty years a Cassini had been connected with the Paris Observatory, and the record was broken only by the upheaval of the French Revolution. The second and third Cassinis were especially active in geodesy, the great map of France being largely their work. After his dismissal from the Observatory in 1793 by the National Convention, Jacques Dominique, Compte de Cassini, retired to his estate and abandoned astronomy entirely.

Astronomers born in 1845 include Sir William Henry Mahoney Christie (died 1922), Astronomer-Royal from 1881 until 1910; Sir George Howard Darwin (died 1912), Plumian professor of astronomy and experimental philosophy at Cambridge from 1883 until 1912; Arthur Cowper Ranyard (died 1894), a founder of the London Mathematical Society and secretary of the Royal Astronomical Society, through whose efforts the tablet to Jeremiah Horrocks in Westminster Abbey was erected, and the distinguished director of the Paris Observatory, François Felix Tisserand (died 1896). The monument erected at Nuits-Saint-Georges to Tisserand was described and illustrated in *Nature* of November 23, 1899. His "Traite de Mécanique Celeste", it has been said, furnishes a faithful and complete résumé of the state of that department of astronomy at the end of the nineteenth century. In the United States, the year 1845 saw the completion of the Cincinnati Observatory, the first of any size in that country. Its erection was due to Ormsby MacKnight Mitchel, the author of "The Orbs of Heaven", a book which greatly influenced Sir Robert Ball when a boy.

Other workers in the exact sciences born in 1845 were William Kingdom Clifford, Gabriel Lippmann and Wilhelm Conrad von Röntgen. In the days of Huxley, Tyndall, Herbert Spencer and Leslie Stephen, there was no more notable figure in intellectual circles than Clifford, who died at the early age of thirty-four after occupying for eight years the chair of applied mathematics in University College, London. "He was admitted on all hands", said the *Athenæum*, "to be the most remarkable mathematician of his generation, and promised to be a second Cayley." Gabriel Lippmann, For.Mem.R.S., who died aboard the *La France* on July 13, 1921, when on his way home from Canada, was born in the Grand Duchy of Luxemburg, but practically all his life was spent in Paris. In 1886 he became director of the Physical Research Laboratory at the Sorbonne, in 1908 was awarded the Nobel Prize for Physics and in 1912 was elected president of the Paris Academy of Sciences. His process of colour photography was announced in 1891.

Clifford's name is known to relatively very few general readers to-day; Lippmann's to a more numerous but select circle; but the name of Röntgen is known everywhere. While March 27 will mark the centenary of his birth at Lennep, a few miles to the west of Düsseldorf, November 8 will be the fiftieth anniversary of his discovery at Würzburg of Röntgen rays, or as he called them, 'X-rays'. "Nov. 8, 1895", said Silvanus Thompson, "will ever be memorable in the history of science. On that day a light, which so far as human observation goes, never was on land or sea, was observed." The discovery was given to the world in Röntgen's paper, "Über eine neue Art von Strahlen", read to the

Physical-Medical Society of Würzburg in December. There was universal recognition of the significance of the step made, and a translation of the paper was published in *Nature* of January 23, 1896. In 1897 the Röntgen Society was founded, but has since (1927) been amalgamated with the British Institute of Radiology. Though born in the Ruhr, Röntgen was educated in Holland and Switzerland. His appointments took him to Würzburg, Strasbourg, Hohenheim and Giessen, then back to Würzburg and finally to Munich, where he died on February 10, 1923.

Passing from the realms of the pure sciences to those of engineering, the year 1845 saw the birth of the versatile inventor and investigator Beauchamp Tower (1845–1905), who will long be remembered for his researches on lubrication carried out for the Institution of Mechanical Engineers. Carl Gustav Patrik de Laval (1845–1913), the Swedish pioneer of the steam turbine; Friedrich von Hefner-Alteneck (1845–1904), the German electrical engineer, and the Swiss hydraulic engineer Theodore Turrettini (1845–1916), were all equally versatile and inventive. With Lord Kelvin, Mascart, Unwin, Sellers and George Forbes, Turrettini was one of the Commission appointed in 1891 to deal with the problem of harnessing Niagara Falls. Karl Benz (1845–1929), the German pioneer of the motor-car, had few of the advantages enjoyed by the foregoing; but he left his mark on a growing industry. He began life as a workman in a Karlsruhe machine-shop, but at the age of twenty-six started on his own at Mannheim. There he produced, in 1885, one of the first vehicles driven by an internal combustion engine. In an entirely different field, we have the names of three eminent British naval architects, Sir William White (1845–1913), Dr. Francis Elgar (1845–1909) and William John (1845–90). All three were shipwright apprentices in the Royal Dockyards, and all three entered the famous Royal School of Naval Architecture and Marine Engineering at South Kensington, in 1864, the year it was opened. For a time their careers ran on parallel lines, but afterwards diverged, John becoming the manager of the Shipbuilding Yard at Barrow, now a part of Messrs. Vickers-Armstrongs, Elgar being nominated the first professor of naval architecture in the University of Glasgow, while White was for nearly twenty years director of naval construction at the Admiralty. By their labours Great Britain was repaid a thousand-fold what the Admiralty had spent on their education.

There was plenty of scientific activity in 1845, though not on the scale of to-day. For its fifteenth meeting the British Association made its second visit to Cambridge. Sir John Herschel was president, and one of the papers was by Joule, who described his paddle-wheel experiments for determining the relation between heat and work. After the gathering, Herschel wrote to Mrs. Somerville in Rome: "We had a full and very satisfactory meeting at Cambridge of the British Association with a full attendance of continental magnetists and meteorologists, and within these few days I have learned that our Government meant to grant all our requests and continue the magnetic and meteorological observations". One of the foreigners present was Von Buch, whom all the leading men of science had met at Dr. Fitton's in London. "At Murchison's request", wrote A. C. Ramsay, "I took Von Buch to Cambridge on the outside of the mail coach from the head of the Haymarket. His luggage consisted only of a small baize bag, which held a clean shirt and clean silk stockings. He wore knee-breeches and shoes." Airy, of course, was at Cambridge and in the Senate House lectured on terrestrial magnetism, keeping his audience, as one writer said, "quite enchained for above two hours". Airy was given to long lectures, and on one occasion at the Royal Institution, his chairman, the Prince Consort, went to sleep. He was indefatigable. As if the directing of the astronomical, magnetical and meteorological work at Greenwich was insufficient occupation, in 1845 he served on the Railway Gauge Commission and a Harbour Commission, planned saw-mills for a dockyard, descended Cornish mines, nearly fainting at the bottom of one, and ascending another by Loam's man engine, "the finest operation that I ever saw", from France sent John Murray an account of the Cherbourg breakwater for Murray's "Handbook" and later in the year dined at York with George Hudson, the 'railway king'.

Early in 1845 at Cambridge, a young man of twenty-one was second wrangler and first Smith's prizeman; one examiner remarking to another, "You and I are about fit to mend his pens". From the University the future Lord Kelvin went to Paris, worked in Regnault's laboratory, and through reading a paper of Clapeyron's learnt about Sadi Carnot's essay, but it took him three years to obtain a copy. Another Cambridge wrangler, Adams, of somewhat more mature age, twenty-six, the son of a Cornish farmer, in 1845 was devoting all his time to his self-imposed task of trying to discover if the behaviour of Uranus could be explained by the presence of a planet no one had ever seen. A young French astronomer, Leverrier, was doing the same thing. Both arrived at the same conclusion, and next year a German astronomer found the planet. A very unscientific controversy arose in scientific circles, but to-day the world honours Adams and Leverrier alike.

The Royal Society in 1845 was in the midst of the long presidency of Spencer Joshua Alwyne Compton, second Marquis of Northampton, who following Davy's practice provided the fellows with tea. Samuel Hunter Christie, father of Sir William, was the secretary, John William Lubbock was treasurer, and after Daniell's death, Colonel Sabine was foreign secretary. The Copley Medal in 1845 was awarded to the Belgian naturalist Theodor Schwann, the Royal Medals to Airy and to the apparently forgotten Thomas Snow Beck, who had investigated the nerves of the uterus. At the Royal Institution, Faraday was pursuing his patient investigations, and in his diary under September 13, 1845, noted his success with glass and magnets, writing: "BUT when contrary magnetic poles were on the same side there *was an effect produced on the polarised ray*, and thus magnetic force and light were proved to have relation to each other".

As to the other scientific bodies, the Chemical Society, then in its fourth year, was presided over by Thomas Graham; the Royal Astronomical Society by Airy, who presented its Gold Medal to that very scientific naval officer Admiral William Henry Smyth, while the Geological Society elected as its president the "mild unpretending, differential" Leonard Horner. Geology was still a thorn in the flesh to the strictly orthodox, and on August 3, 1845, Mrs. Somerville wrote to her son: "The papers (I mean *The Times*) are full of abuse of Mr. Sedgwick and Dr. Buckland, but their adversaries write such nonsense that it

matters little". On April 1 the Geological Survey had been finally taken away from the Master-General and Board of Ordnance and placed "under the direction and supervision of the First Commissioner of Her Majesty's Woods, Forests, Land Revenues, Works and Buildings". The most important geological book of the year was the fine volume by Murchison and his associates, "The Geology of Russia in Europe and the Ural Mountains", dedicated to the Czar and containing coloured gold pin-pointed maps showing the mineral deposits from the northern extremity of the Urals to the Donetz Basin.

Experimental science still languished at Oxford and Cambridge, and in spite of the work of Graham at University College and of Daniell at King's College, London was sadly in need of chemical laboratories. Largely through the Prince Consort, this need was met in 1845 by the opening in Oxford Street of the Royal College of Chemistry, where twenty-six students gathered to sit at the feet of a young *privat-docent* from Bonn, August Wilhelm Hofmann. In those far-off days, there was no talk of "blood and iron", "mailed fists" or "racial superiority", and there was free and friendly intercourse between German and British men of science, to the great advantage of both. Hofmann remained in London until 1864, but he came back later, his last appearance being in 1884, when he presided over the dinner given in honour of one of his most famous pupils, William Henry Perkin.

By 1845 the peace had lasted thirty years and there was money to spend on all sorts of projects. The railway mania had set in, and Robert Stephenson was returning big cheques sent to him more or less as bribes. Some half a dozen railway lines, including those between Bristol and Gloucester, London and Cambridge and Manchester and Sheffield, were opened during the year, and as the railways spread so did the electric telegraphs. For a shilling, visitors to Paddington or Slough could see "this interesting and most extraordinary Apparatus by which upwards of 50 SIGNALS can be transmitted to a Distance of 280,000 miles in ONE MINUTE". The best advertisement, however, was the announcement of the arrest at Paddington through the use of the telegraph of the Slough murderer John Tawell. For the first time, too, a newspaper published a report of a meeting transmitted by electricity. Two years before, Colt, of revolver fame, had laid a submarine cable in New York harbour, and in Britain the Bretts were dreaming of a cable between England and France. Sea transport was undergoing a revolution. Steam vessels were found everywhere, iron ship-building was becoming an industry, and the trials of H.M.S. *Rattler* in 1845 showed the pioneers that screw propulsion was possible for even the stately three-decker line-of-battleship. By the spring, the famous iron screw steamer *Great Britain*, once called the *Mammoth*, was nearing completion, and on April 23, 1845, *The Times* said: "Yesterday Her Majesty and Prince Albert paid their contemplated visit to this extraordinary vessel". Brunel had the honour of explaining everything to the Royal party, and Francis Pettit Smith, otherwise "Screw" Smith, presented "a very beautiful model in gold, in an appropriate case, of the propeller he had recently fitted to Her Majesty's new tender yacht Fairy". The *Great Britain* sailed on her maiden voyage on July 26, 1845, and so opened another chapter in trans-Atlantic travel.

OBITUARIES

Sir John Fox, C.B., O.B.E., F.R.S.

JOHN JACOB FOX, eldest son of Mark and Hannah Fox, was born in London on April 12, 1874, and died on November 28, 1944. He received his scientific education at the Royal College of Science, South Kensington, and at Queen Mary College, London, taking the B.Sc. degree by research in 1908 and the D.Sc. degree two years later. He was elected a fellow of the Royal Institute of Chemistry in 1916. He entered the Government service in 1896 and was appointed to the permanent staff of the Government Laboratory in 1904. He became superintending chemist in 1920, deputy Government chemist in 1929 and Government chemist in 1936.

During his official career, Fox was called upon to undertake work concerning a number of problems of interest not only to Government departments but also to the general public. Among these the following may be mentioned: the possibility of substituting for white lead either less-soluble compounds of lead or 'leadless' glaze; the causes of the decay of buildings; the pollution of rivers by drainage from tarred roads; the cleaning and restoration of wall paintings. His encyclopædic knowledge of organic chemistry and his sound judgment were called into play in organizing the sections of the Laboratory set up to advise the Board of Customs and Excise in the administration of the Safeguarding of Industries Act and of the duties on silk and artificial silk and on hydrocarbon oils. As Government chemist he was chairman of the Road Tar Research Committee and of the Committee on Physico-chemical Problems of the Building Research Board. In 1939 he threw himself with great energy into scientific matters connected with the prosecution of the War. This aspect of the work of his last years cannot yet be described in detail, but it can be stated that he served on numerous departmental committees and was a member of the Hydrocarbon Oil Duties Committee at the time of his death.

Fox found time to undertake a great deal of research. In his early years his mind turned to organic chemistry, and in this period he published researches in the acridine series and on the derivatives of 8-hydroxyquinoline and was joint author of the discovery of a new aromatic hydrocarbon diphenylene. Later he was interested in spectroscopy and its relation to molecular structure. The ultra-violet absorption spectra of alkaloids, sulphur, the halogens and light elements was studied. His work on the infra-red absorption spectra of diamond and of some carbon compounds, carried out in collaboration with colleagues in the Government Laboratory, led to the recognition of two types of diamond and to the elucidation of some difficult problems in analytical chemistry. Difficulties arising in his official work suggested researches on the solubility of lead sulphate in ammonium, potassium and sodium acetates, on mannito-boric acid and on the composition of some medieval waxes. He also published researches on new and improved methods of analysis.

Fox had a very alert mind, a photographic memory and abundant energy. In addition to the numerous research institutions to which he was appointed in his official capacity, he gave his time freely to the work of scientific societies. He was a past president of the Royal Institute of Chemistry, of the Oil and Colour Chemists' Association and a vice-president of

the Society of Chemical Industry. He served on the Council of the Chemical Society and was a manager of the Royal Institution. He always had at heart the welfare of Queen Mary College, its students and its old students. He was one of a small band of distinguished old students who met together several times a year to keep track of old members of the College and to give them a helping hand when necessary. He was made a fellow of Queen Mary College in 1937.

Fox was always willing to help : he never allowed red-tape to interfere with his official contacts with industry. He gladly saw the representatives of chemical manufacturers and other traders, and freely gave his knowledge and experience to help them to overcome those difficulties inseparable from governmental control. Although his whole life was devoted to the service of chemistry, he yet found time to act as treasurer of his church for many years. He was kind and generous to his colleagues and lost no opportunity of encouraging those young members of his staff who showed a lively interest in chemistry. His enthusiasm for chemistry remained to the end, when he could still be seen moving from room to room of the Laboratory—asking, suggesting, encouraging.

His services were rewarded by the honour of the O.B.E. in 1920, of the C.B. in 1938 and of a knighthood in 1944 ; his services to chemistry were acknowledged by the Royal Society in 1943, when he was elected a fellow. He leaves a widow, a son and a daughter. A. G. FRANCIS.

Sir Percy Nunn

THAT so distinguished a career as that of Sir Percy Nunn should have terminated in a sort of banishment from his native land, and therefore from the scenes and causes to which he had devoted his eminent gifts, must indeed be accounted a tragedy. So long as he was able to spend a few summer months in England, after many months of exile to Madeira for reasons of health, his lot seemed tolerable. But the grim course of world events meant for him complete exile, a condition which, however, his nobility of character enabled him to bear with exemplary patience and fortitude. He died on December 12 at the age of seventy-four.

That Nunn was first of all, at least in the chronological sense, a man of science, is shown by his first substantial piece of writing, his "Aims of Scientific Method", and by his subsequent work on the nature and teaching of mathematics. It is scarcely too much to say, however, that even then, and still more decidedly later on, when he became an active member of the Aristotelian Society, he was essentially a philosophic thinker. The broad philosophic outlook characterized all his literary work. He wrote a book bearing the modest and not uncommon title "Exercises in Algebra". The book must have been a sore puzzle to teachers who had not got far from the 'Hall-and-Knight' tradition. It was, in fact, the result of years of teaching combined with reflexion, and finally of many months of patient and laborious research in the British Museum and elsewhere. It could not be a best-seller in the secondary schools, but it could, and it did, help towards a reorganization of school mathematics.

At a later stage in Nunn's career, he published his well-known "Education : its Data and First Principles", a work which summed up in brief compass the substance of his courses of lectures on the subject. That book, published two years after the end of the first world war, was, for one thing, a marvel of prophecy as to the shape of things to come. The author's main purpose was "to re-assert the claim of Individuality to be regarded as the supreme educational ideal, and to protect that ideal against both the misprision of its critics and the incautious advocacy of its friends". The book, remarkable both for its clear vision and its massive learning, still stands as the finest systematic defence of the only educational ideal which can make the world safe for democracy.

Some of Nunn's old friends will remember how, as vice-principal of the new London Day Training College, he was introduced to them nearly forty years ago, by the principal, the late Sir John Adams, in a rather dingy little room near Holborn which formed the temporary headquarters of the College. These were the roots, the fruits of which are seen to-day in the great University Institute of Education. That development was mostly due to the creative genius of one man, and that man was Percy Nunn. No longer is it necessary that teachers in the British Commonwealth of Nations should go to the United States if they wish to pursue advanced studies in education. They can now get what they want in England, thanks to the efforts of Sir Percy Nunn, and to those of his singularly appropriate successor, Sir Fred Clarke.

As the advocate of a cause, Nunn was a persuasively quiet and eloquent speaker. There was a marvellous flow of language, but every word told. He was a true and loyal friend and a delightful companion, and in his exile he liked to recall in his letters the days of small things in a distant past. T. RAYMONT.

Mr. J. Edmund Clark

JAMES EDMUND CLARK died on December 16 at the age of ninety-four. He was the last of the fourteen children of James and Eleanor Stephens Clark. His father died at the age of ninety-four, and the average age of his nine brothers and sisters who reached maturity was more than eighty-two when they died. His mother was one of a family of seventeen children.

Clark was educated at Bootham School, York, at University College, London, and at the University of Heidelberg. He returned to the famous Quaker school for boys at York as junior master during 1869–72, and after further training, he succeeded his life-long friend, later Prof. Silvanus P. Thompson, as science master at Bootham in 1875. After twenty-two years as a schoolmaster, he gave it up, largely because of deafness, and went to London in 1897, where he began a new career as export merchant. He retired in 1929.

Keenly concerned as Clark was for every branch of natural science, it was meteorology and phenology which particularly claimed his interest. For twenty-five years he was secretary of the Phenological Committee of the Royal Meteorological Society, and was for long a member of the Society's Council. High tribute was paid, when he retired in 1936, to his services to phenological studies on the effect of climatic conditions on natural phenomena.

In 1879 Clark married Lucretia H. Kendall, of Boston, Mass. She died in 1937, as did also their only son, Roderic. Throughout his life, Clark was a devoted and active member of the Society of Friends in York, Croydon, Purley and Street.

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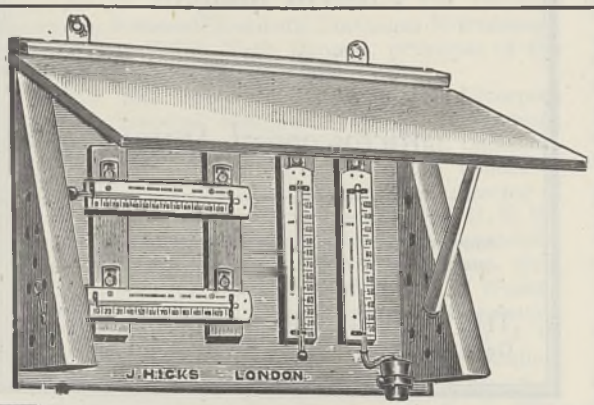

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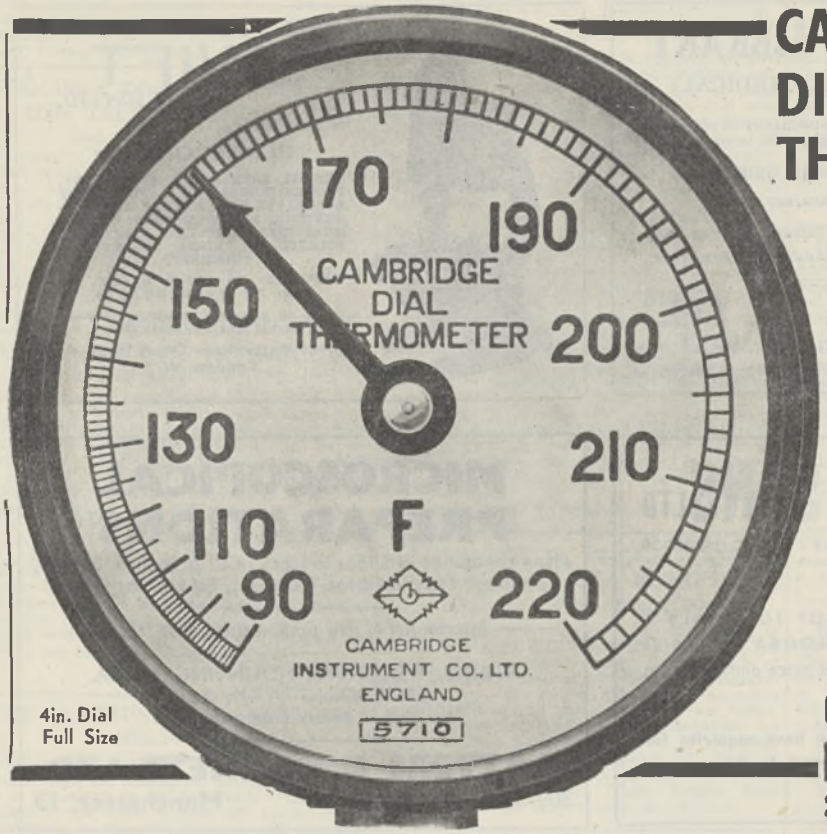

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NEWS and VIEWS

New Year Honours List

THE following names of scientific workers and others associated with scientific activities appear in the New Year Honours list:

Order of Merit: Prof. A. N. Whitehead, professor of philosophy in Harvard University.

Baronet: Sir Alfred Webb-Johnson, president of the Royal College of Surgeons.

K.B.E.: Sir Stanley Angwin, engineer-in-chief, General Post Office.

Knights: Prof. L. P. Abercrombie, professor of town planning, University of London; Dr. E. B. Bailey, director of the Geological Survey of Great Britain; Mr. F. W. Bain, chairman of the Chemical Control Board, Ministry of Supply; Prof. J. Chadwick, professor of physics, University of Liverpool, for services to the Department of Scientific and Industrial Research; Dr. A. P. M. Fleming, a director of Metropolitan-Vickers Electrical Co., Ltd., for services to education; Mr. R. G. Hetherington, adviser on water and director of water surveys, Ministry of Health; Mr. W. P. Hildred, director-general of civil aviation, Air Ministry; Mr. C. C. Inglis, director of the Indian Waterways Experiment Station, Poona; Prof. E. H. Minns, emeritus professor of archæology and president of Pembroke College, Cambridge; Diwan Bahadur Arcot Lakshmanaswami Mudaliyar, vice-chancellor of the University of Madras; Dr. C. W. B. Normand, lately director-general of observatories, India; Mr. J. F. Rees, principal of the University College of South Wales and Monmouth, Cardiff, vice-chancellor of the University of Wales; Dr. R. E. Stradling, chief adviser, Research and Experiments Department, Ministry of Home Security; Bomanji Jamshedji Wadia, vice-chancellor of the University of Bombay; Brig. L. E. H. Whitby, lately bacteriologist at the Middlesex Hospital, for services in the development of the sulphonamide group of drugs; Prof. E. T. Whittaker, professor of mathematics in the University of Edinburgh.

C.M.G.: Mr. D. L. Blunt, director of agriculture, Kenya; Mr. A. R. Callaghan, principal of the Roseworthy Agricultural College, South Australia, for public services; Mr. G. C. Turner, principal of the Makerere College, Uganda.

C.I.E.: Daulat Ram Sethi, agricultural production and marketing adviser, India; Mr. H. S. George, chief conservator of forests, Central Provinces and Berar; Mr. J. B. T. Brooks, chief conservator of forests, Bombay; Mr. F. C. Minett, director of the Imperial Veterinary Research Institute, Izatnagar-Mukteswar; Rai Bahadur Tridib Nath Banarji, principal of the Prince of Wales Medical College, Patna.

C.B.E.: Mrs. Mary G. Blacklock, the Liverpool School of Tropical Medicine; Mr. J. P. Bowen, engineer-in-chief to Trinity House; Mr. H. Campion, director of the Central Statistical Office, Offices of the War Cabinet; Mr. H. J. E. Dumbrell, director of education, Bechuanaland Protectorate; Mr. R. E. W. Flower, lately senior deputy keeper of manuscripts, British Museum; Mr. J. P. Bushe-Fox, chief inspector of ancient monuments, Ministry of Works; Major J. Keith, chairman of the Board of Governors, North of Scotland College of Agriculture; Mr. J. R. Learmonth, surgical director, Emergency Medical Services, S.E. Area of Scotland, and professor of surgery, University of Edinburgh; Mr. R. C. Marshall, chief conservator of forests, Gold Coast; Mr. W. L. Taylor, forestry commissioner; Mr. R. R. Waterer, conservator of forests, Cyprus.

The Next 11-Year Solar Cycle Begins

THE recent appearance of a big sunspot (visible at times to the unaided eye), together with four or five smaller groups overlapping in time, probably signifies that the rise in solar activity towards its next maximum has now definitely begun. This major group of spots in south latitude 22° crossed the sun's disk between December 8 and 20 last, the time of central meridian passage being December 14·3. A considerable disturbance in the earth's magnetic field occurred on December 16–17, with associated disturbed conditions for long-distance radio communication. For the past eighteen months, high latitude (20°–40°) sunspots have begun to appear in increasing numbers, giving the characteristic overlap seen at this epoch of the 11-year cycle with the decreasing old-cycle spots in equatorial latitudes (0°–10°). The routine observations of the magnetic fields of sunspots, carried out at the Mount Wilson Observatory (*Proc. Ast. Soc. Pacific*, Oct. 1944) show that the anticipated reversal of the magnetic polarity of comparable sunspots has taken place with the appearance of the new cycle spots, as first observed by Hale at the sunspot minimum of 1913. Sunspot frequency during 1943–44 gives a minimum at about 1944·5. The rise from minimum to the following peak of the cycle takes on the average 3½–4 years; but individual cycles vary in amplitude and time of phase, not subject to prediction.

Earthquake in Britain

AN earth tremor approximately of scale 4½ on the modified Mercalli scale (scale 5—felt by nearly everyone, many awakened, some dishes, windows, etc., broken, a few instances of cracked plaster, unstable objects overturned; disturbance of trees, poles and other tall objects sometimes noticed; pendulum clocks may stop) in the epicentral region occurred on December 30, 1944, about 12.35 a.m. G.M.T. It was recorded on Mr. J. J. Shaw's seismograms at West Bromwich, and here the record lasted about two minutes. The seismograph at Stonyhurst College Observatory was unhinged by the shock so that the full record was not obtained. Reports are not yet to hand from other observatories. The tremor was felt by people over a radius of approximately a hundred miles, and was reported from Carlisle, Newcastle, Norfolk, Derby and intermediate places. No damage or casualties have been reported. So far as can be ascertained there was no noise associated with the tremor. In the north of England this was the greatest tremor since the North Sea earthquake (epicentre latitude 53·7° N., longitude 1·3° E.) of June 7, 1931. A somewhat greater tremor shook Scotland and England on October 23, 1839, when the epicentre was near Comrie.

Mepacrine

AN important statement on the anti-malarial drug mepacrine B.P. (quinacrine hydrochloride of the United States Pharmacopoeia, also called 'atebrin' or 'atabrin') has been issued by the Medical Research Council's Committee on Malaria (*Brit. Med. J.*, 664, Nov. 18, 1944, and the *Lancet*, 667, Nov. 18, 1944). In view of the great importance of malaria in warfare in the Far East and the Mediterranean area, a

great deal of work has been done recently on the relative merits of the two chief anti-malarial drugs at present available, namely, mepacrine and quinine. Before the War the world's supply of quinine came almost entirely from Java, and, when the Japanese captured this island, they also cut off practically the whole supply of this essential drug. The Allied Nations turned, therefore, to mepacrine, originally made by the I.G. Farbenindustrie, which announced its manufacture in 1932. Mepacrine has an acridine nucleus with a long side-chain ending in a substituted amino-group. It may stain the skin yellow when it has been taken by the mouth in large quantities. Its manufacturers stated that its anti-malarial action is as powerful as that of quinine, and this was confirmed during the Ceylon epidemic in 1935. One of the advantages claimed for it was that it is less likely than quinine to cause vomiting or to be followed by blackwater fever; but its action was said to be slower and, in a small proportion of cases, it was apt to cause symptoms resembling those of epilepsy or mania.

The relative merits of the two drugs have now been evaluated. The United States Board for the Co-ordination of Malarial Studies has resolved, as the result of quantitative studies in civilian, Army and Navy establishments, that no advantage, and possible disadvantage, to the Armed Forces would follow if quinine or totaquine U.S.P. (which is a product containing cinchona alkaloids with an activity approximately equal to that of quinine) replaced mepacrine for the routine suppression and treatment of malaria; that the large-scale production of quinine or totaquine is not now important for the management of malaria in Army and Naval personnel, although increased supplies of totaquine may be required for civilians temporarily controlled by the Armed Forces; and that there will be, after the War, a continued great need for anti-malarial drugs. The Medical Research Council's Committee on Malaria endorses these conclusions and agrees in general with the American views. This Committee says that mepacrine, under proper administration, is no more liable to cause toxic effects than is quinine, and that mepacrine is not an inferior substitute forced upon us by the Japanese occupation of Java; it is a more effective anti-malarial agent which would still be used if the supplies of quinine were unlimited.

Child Health

THE City Council of Liverpool, together with the University and the Merseyside Voluntary Hospitals have combined to finance a chair of child health, which was opened on October 27 last (*Lancet*, 608, Nov. 4, 1944). This new department will teach the subject to undergraduates and, in postgraduate courses, to medical men. Liverpool thus follows the lead given by Edinburgh as long ago as 1931. The generosity of the Nuffield Foundation has made possible the creation of a chair of child health in London, where a postgraduate institute is to be created in association with the Hammersmith Postgraduate Medical School and the Great Ormond Street Hospital for Sick Children (*Brit. Med. J.*, 410, Sept. 23, 1944). The Nuffield Provincial Hospitals Trust has also assisted the endowment of a chair of child health at King's College, Newcastle-upon-Tyne.

It is clear that the children of the future are to be attended by medical men who have had more training in the diseases of children than practitioners now obtain. The health of their mothers is already the subject of much instruction and organization, and will also, it is to be hoped, be a prominent feature of medical work of the future. The Children's Nutrition Council hopes to see, after the War, a campaign among housewives about foods and food-habits.

Immigration in the British Commonwealth

A PEP broadsheet, "People for the Commonwealth" (No. 226), gives a review, with statistical appendix, of prospects for migration to the Dominions. The broadsheet concludes that the sparsely populated Dominions would benefit from a marked increase in population: their standard of living would thereby be higher and their military security buttressed. Natural increase is bound to be slight, even if the decline in fertility in the Dominions can be checked and even if death-rates continue to fall. There is no alternative to immigration, and it has been estimated that Canada should have 50 instead of 11·5 million people, Australia 20 instead of 7 million, South Africa 5 instead of 2·5 million white people, New Zealand 5 instead of 1·5 million. In the past, non-British immigration has been rigidly restricted to safeguard the British character of the Dominions, which still want British emigrants. All the Dominion Governments are receiving applications from people who want to leave Britain; but such discrimination will in future be incompatible with a large volume of immigration, since there are not likely to be many British emigrants after the War; nor will there be many from the other nationalities which have traditionally been preferred. In the inter-war period, Britain assisted emigrants to the Dominions. If such assistance is once again given after the War and evokes substantial response, the imminent decline in British population will be hastened, and in view of its ageing population, Britain's own standards of living will thereby be prejudiced and the task of reversing the decline made more difficult. If immigration from Asia is excluded, the only remaining source will be the countries of southern and eastern Europe, and there is no reason for thinking that, given time and expansionist economies in the Dominions, nationals of these countries could not be successfully absorbed.

Michigan Academy of Science, Arts and Letters

VOLUME 22 of the Michigan Academy of Science, Arts and Letters contains communications upon a wide range of subjects including, *inter alia*, forestry, geography, anthropology, history and philosophy (Papers of the Michigan Academy of Science, Arts and Letters. Vol. 28 (1942). Pp. xiii+701+52 plates. Ann Arbor, Mich.: University of Michigan Press; London: Oxford University Press, 1943. 28*s*. net). Most of the botanical papers deal with the determination of species in the lower plants. There is an ambitious and critical monograph on the *Leucopaxillus* (toadstools) by R. Singer and A. H. Smith, with chemical and microscopical data. Several papers deal with tropical marine Algæ, and a number of new Red Algæ are described. G. W. Prescott and A. M. Scott give about a hundred good line drawings of American forms of *Micrasterias* (a desmid), including many known in Britain and several new ones. Finally may be mentioned a charming little paper on the pollen of a Swedish bog by E. Janson and E. Halpert, who wondered whether the European facts could be as clear-cut as have been reported, but found they were so. The zoological papers deal with various topics from Arthropods to reptiles. It is known that

the common garter snake of North America can mate either in the autumn or in the spring. F. C. Blanchard has investigated the matter more fully and found evidence to show that effective mating occurs commonly in the autumn in the wild state. The offspring from such matings, if the females are kept isolated, exhibit normal Mendelian ratios in their colour pattern. In the wild, such females may copulate again in the spring and the resulting offspring show colour patterns that bear no relationship to any Mendelian ratio, and so it would appear that the actual insemination resulting from the autumn mating does not occur until after the spring mating. W. C. Beckman shows that in a number of game fishes in Michigan, temperature plays the leading part in the annulus formation in the scales. The mean temperature of the first days on which the majority of the scales showed an annulus is 58° F. An interesting paper by C. L. Hubbs and R. R. Miller deals with the influence of changed environment upon interspecific hybridization of two generations of Cyprinodont fishes.

Quality Control Technique

A USEFUL booklet entitled "Quality Control Chart Technique when Manufacturing to a Specification", by B. P. Dudding and W. J. Jennett, has recently been published by the General Electric Co., Ltd., of England (Research Laboratories, G.E.C., Wembley. 2*s*. 6*d*.). The booklet describes a more detailed development of the principles discussed in British Standard 600 *R* (1942), and the major aim of the technique described is to assist production to specification requirements with the elimination of waste labour and material. While the handbook is intended principally as a guide for those concerned with the machine manufacture of articles to dimensional limits, it should be helpful to anyone introducing the technique for use in other types of manufacture. The book is arranged in two parts with appendixes. Part 1 deals with quantitative data and is concerned with the utilization of results of measurement. Part 2, giving qualitative data, is concerned with the utilization of the results of classifying a product into categories as, for example, 'defective' and 'effective'. Suggestions are made with the view of increasing the value of control charts for number defective in those cases where this method has to be adopted or it is preferred on grounds of convenience and/or cost.

Production Control in Industry

UNDER the title "Production Control in the Small Factory: Office Aid to the Factory" (B.S. 1100. Part 2. 1944), the British Standards Institution has issued a booklet designed to advise on production control technique in the small factory. The need is stressed for control in order to make it possible economically to increase production and to eliminate waste of time and effort. The practice and procedure recommended are illustrated by taking as example a firm in which between fifty and sixty people are employed in the manufacture of jigs and fixtures for small assemblies. The number of schedules, records and documents is kept down to the minimum for simple control over issuing quotations, purchasing and stock, volume of work to be handled, flow of work to shops, production instructions, time-keeping and costs. The methods described are illustrated with specimen schedules, cards, record sheets, and a comprehensive order flow chart, which shows the various stages through which an order will pass. By careful study of these recommendations, factory managers should be able to adapt them to their firm's individual needs.

Lighting Reconstruction

THE Illuminating Engineering Society has now issued the fifth of the series of its Lighting Reconstruction Pamphlets, the present one dealing with city and highway public lighting. The pamphlet discusses what might well be done in the way of public lighting in the post-war period, and it offers useful guidance, with the view of achieving maximum benefit to those concerned. The pamphlets are obtainable from the Society at 32 Victoria Street, London, S.W.1, at the uniform price of 1*s*. each, 9*s*. a dozen or £3 a 100.

Announcements

MR. GEORGE SMITH, of the London School of Hygiene and Tropical Medicine, has been elected president of the British Mycological Society for 1945.

AT the meeting of the London Mathematical Society on January 25, at 3.0 p.m., in the rooms of the Royal Astronomical Society in Burlington House, Prof. J. Hadamard, of the Paris Academy of Sciences, will give his postponed lecture "Psychological and Personal Recollections of a Mathematician". Members of other scientific societies will be welcome.

A COMPREHENSIVE review of progress in industrial and medical radiology is contributed by Bernard John Leggett to the November issue of the *Journal of the Institution of Electrical Engineers* (91, Part 1, No. 47). The paper reviews atomic physics, the cyclotron and betatron, the generation of high voltage and design of high-voltage X-ray tubes, industrial radiology, medical radiology and bio-electric phenomena. A bibliography of sixty-seven items accompanies the paper.

AN Annotated Bibliography of Medical Mycology, edited by Dr. S. P. Wiltshire, in collaboration with Dr. Charles Wilcocks and J. T. Duncan (Imperial Mycological Institute, Kew, Surrey, 1944. Pp. 32. 5*s*.), lists all papers on medical mycology which were either published in 1943 or noted by abstracting journals during that year. Authors and subjects are indexed. Short summaries follow most of the headings. If these summaries can be enlarged in future years, the value of this publication will be greatly enhanced. The Bibliography can be recommended as a work of reference for dermatologists and pathologists.

CATALOGUE 63 of scientific books issued by Ifan Kyrle Fletcher, "Merridale", Caerleon, Mon., contains among others the following works of interest: Andrea Bacci's "De thermis libri system" (1571), Bateman's "Practical Synopsis on Cutaneous Diseases" (1824), first edition of Sir Thomas Browne's work (1686), Cheselden's "Anatomy of the Human Body" (1741), Cornaro's "Discourse on a Sober and Temperate Life" (1779), Fabricius ab Aquapendente's "Opera omnia anatomica et physiologica" (1687), John Freind's "Opera omnia" (1723), Sir John Harington's "Metamorphosis of Ajax" (1814), J. F. C. Hecker's "Epidemics of the Middle Ages" (1846), "Lunacy Acts" (1798–1824) and Mesué's "De re medica" (1542).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Existence of Time-dependence for Interfacial Tension of Solutions

IN a recent note under this title, Ward and Tordai[1] have pointed out that the interfacial tension between water and hexane solutions of lauric acid attains equilibrium at an anomalously slow rate, and suggest that this arises from a process of high activation energy being involved subsequent to the diffusion of solute molecules to the interface. The observed marked effect of temperature in hastening equilibrium was taken as support for this view.

Slow accumulation at an interface has been much discussed recently, and this further very interesting example would appear to be closely related to the slow ageing of surface tension of hydrocarbon solutions of dodecyl sulphonic acid[2]. A suggestion put forward to explain this latter phenomenon ascribed it to the slow breakdown at the surface of the strongly associated solute molecules[3], since on general grounds strong molecular association would be expected in such hydrocarbon media.

A somewhat similar picture may hold for the lauric acid/hexane system with its well-known monomer-dimer association. The polar groups in the dimer would be largely screened by the randomly kinked fatty-acid hydrocarbon chains, and on collision of the dimer with the interface could but seldom approach the aqueous phase sufficiently closely for interaction, and hence for the subsequent dissociation and re-orientation, to occur. As a first approximation, therefore, the dimer *per se* might be regarded as completely ineffective for bringing about equilibration. With the monomer, this particular restriction clearly would not exist, and the observed slow rate of equilibration would then arise from the small proportion of fatty acid existing in the monomeric state, which in hexane solutions would be expected to be very low indeed. (Even with the monomer a considerable proportion of the collisions with the surface would be ineffective owing to the large size of the hydrocarbon chain relative to that of the carboxyl group, but this can be estimated and is unlikely to be less than 10^{-2}.)

If this picture is correct, the time required for interfacial equilibrium should decrease with decreasing molecular association in the hydrocarbon medium. Accordingly solutions in nujol, in benzene and in nitrobenzene, of palmitic acid and of an oil-soluble detergent ('Aerosol OT', from the British Cyanamid Co.), have been studied, and the times for equilibration are found to decrease from several days with nujol to a few hours or minutes with nitrobenzene. No equilibrium constants for the association of fatty acids in nujol appear to be available, but it is certain that the extent of dissociation into monomer would increase in the above order[4].

The marked temperature coefficient observed is then readily explained as arising from the high ΔH value for the monomer-dimer association reaction, which is about 16·5 Cal. in the gas phase[5], greater than 9·7 Cal. in benzene[6], and about 6·0 Cal. in nitrobenzene[7].

This suggested explanation, if confirmed by further work, would provide another means of estimating the degree of association of polar compounds in hydrocarbon media, and hence of equilibrium constants and heats of association. It should be particularly useful for cases showing high association constants and for compounds insoluble in water, where the usual methods based upon freezing points, infra-red absorption spectra and distribution, are not suitable.

A. E. ALEXANDER.
E. K. RIDEAL.

Colloid Science Department,
University, Cambridge.
Nov. 28.

[1] Ward and Tordai, *Nature*, **154**, 146 (1944).
[2] McBain and Perry, *J. Amer. Chem. Soc.*, **62**, 989 (1940).
[3] Alexander, *Trans. Far. Soc.*, **37**, 15 (1941).
[4] Francois, *C.R. Acad. Sci.*, **193**, 1008 (1931). Broughton, *Trans. Far. Soc.*, **30**, 367 (1934).
[5] "Int. Crit. Tables", **7**, 246 (acetic acid).
[6] Moelwyn-Hughes, *J. Chem. Soc.*, 850 (acetic acid).
[7] Private communication from Dr. M. M. Davies (propionic acid).

Photographic Fourier Synthesis

IN 1929, Sir Lawrence Bragg[1] showed that electron density projections and Patterson projections of crystal structures could be synthesized by the photographic addition of patterns of light and dark bands of proper period and orientation, one pattern for each term in the series. Later[2], I showed that such syntheses can be made easily and rapidly if one has available a set of suitable masks. These are inserted successively into a photographic enlarger and exposures made through them, the exposure times being proportional to the F or F^2 values—the coefficients of the individual terms in the series.

In making an electron density projection, the desired summation is

$$\sum_{hk} F_{hko} \cos 2\pi (hx + ky),$$

where x and y are co-ordinates in the projected unit

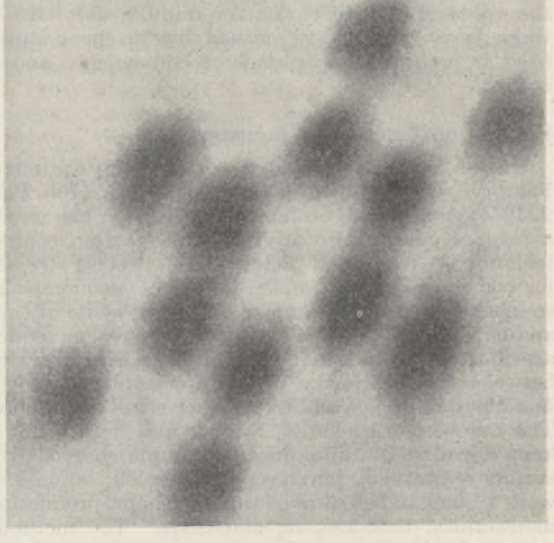
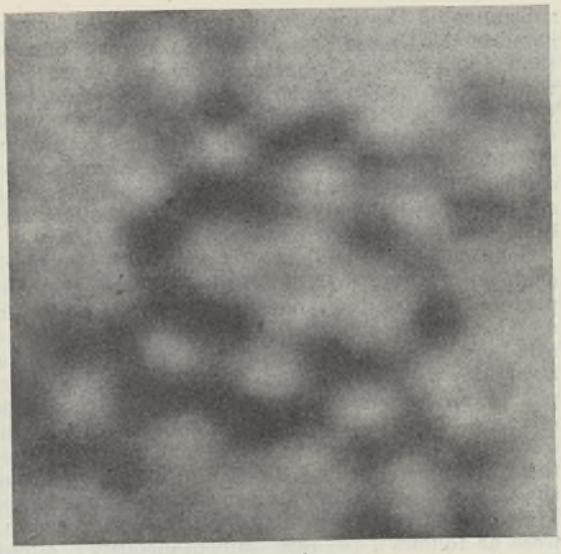


Fig. 1. PHOTOGRAPH OF A HEXAMETHYLBENZENE MOLECULE, OBTAINED BY PHOTOGRAPHIC FOURIER SYNTHESIS FOR X-RAY DATA BY BROCKWAY AND ROBERTSON[3].



10^{-8} cm.

Fig. 2. PHOTOGRAPH OF A PHTHALOCYANINE MOLECULE, FROM X-RAY DATA BY ROBERTSON[4].

cell. If the distribution of light transmission through each mask is

$$1 + \cos 2\pi (hx + ky),$$

the total light intensity reaching the photographic emulsion (on which the picture is being made) is the desired summation plus a uniform, unwanted background. The effect of this uniform background illumination can be nearly eliminated by using a photographic material—such as Velox F5, Kodalith paper or Kodalith film—with a suitable characteristic curve. Although not necessary for crystal structure analysis, the remaining background can be entirely removed by treatment with a reducer solution or by reprinting, using appropriate film and paper.

With the aid of the Physics Department of these Laboratories, an improved set of masks has recently been made, on a roll of 35 mm. film. Examples of syntheses obtained with these new masks are shown in the accompanying figures. In Fig. 1 the background has been partly removed by reprinting.

The departure from a perfect hexagonal structure in Fig. 1 is in part due to inclination of the molecule relative to the plane of the projection, and in part to the representation of the actual unit of the projection—a parallelogram with unequal sides and angles—by a square. In Fig. 2 these two factors practically cancel each other, the photograph showing the appearance of the phthalocyanine molecule with the line of vision normal to the plane of the molecule. If wanted, projections having the shape of the true unit can be produced by any of several procedures, now in process of being tested here.

We hope soon to be able to furnish copies of these masks, at a nominal cost, to others doing crystal structure work.

MAURICE L. HUGGINS.

Kodak Research Laboratories,
Rochester, N.Y.
Oct. 9.

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Grignard Compounds as Condensing Agents

IT is already known that Grignard compounds may act as reducing agents[1,2], or cause enolization of ketones[3,4], or bring about the condensation of esters of some fatty acids to β-keto-esters. The present communication records some observations on the condensation of ketones during the Grignard reaction.

It was observed during the preparation of some tertiary alcohols by reaction of alkyl magnesium halides with ketones that the product contained greater or smaller amounts of condensation product. Thus pinacolin (I) and *tert.*-butyl magnesium chloride gave as principal products, pinacolyl alcohol and a mixture of the hydroxy ketone (III) and the unsaturated ketone (II). None of the required alcohol could be isolated. Ethyl magnesium bromide also gave notable amounts of these condensation products, as did also phenyl magnesium bromide.

$$(CH_3)_3C.CO.CH_3$$
(I)
$$(CH_3)_3C.CO.CH:C(CH_3).C(CH_3)_3$$
(II)
$$(CH_3)_3C.CO.CH_2.C(OH)(CH_3).C(CH_3)_3$$
(III)

A survey of the literature has shown that the formation of condensation products from ketones during Grignard reactions has been frequently recorded without any further characterization or identification[1]. Only two recorded examples of the identification of such products have so far come to our notice[3,5]. It would now appear that the self-condensation of ketones during the Grignard reaction is more general than is commonly supposed, and that by selecting suitable reactants it may become the main reaction.

The experimental data at present available leads to the conclusion that alkyl magnesium halides with highly branched chains not only bring about reduction of the ketone but also promote condensation. The structure of the ketone is also an important factor; those with an available hydrogen adjacent to the carbonyl and a slow rate of reaction towards Grignard reagents condense more readily. If they react with Grignard reagents which do not cause reduction, such as the aryl magnesium halides, the formation of the condensation is still more favoured.

W. J. HICKINBOTTOM.
E. SCHLÜCHTERER.

Chemistry Department,
University, Birmingham, 15.

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Rates of Oxidation of Different Substrates in the Frog's Liver

IN the course of preliminary studies in an investigation regarding the mechanism of the regulation by hormones of enzymic processes, we have carried out determinations of the respiratory quotient (*RQ*) of the liver tissue with homogeneous material from the frog (*Rana temporaria*) in the summer state. For each specimen a determination of respiratory quotient was performed on slices by a modification[1] of the method of Meyerhof and Schmitt. The values obtained varied between 0·70 and 1·00. When the values of the oxygen consumption per mgm. fresh weight were

correlated with the corresponding values of the respiratory quotient, it was found that high values of the latter were accompanied by low oxygen consumptions and vice versa. It follows that different substrates occurring in the liver of the frog are oxidized at different rates.

A more detailed account of the results will shortly be published elsewhere.

P. E. LINDAHL.
CHR. WERNSTEDT.

Wenner-Gren's Institute for
Experimental Biology,
University of Stockholm.

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Effect of Anoxia on Excitation and Impulse Propagation in Isolated Motor Nerve Fibres

ALTHOUGH the paralysing action of anoxia on peripheral nerve has been frequently studied in previous investigations, so far as we know, no attempt has as yet been made to examine whether excitability and propagation of the nervous impulse react identically to lack of oxygen.

Monophasic action potentials of isolated motor nerve fibres (sciatic nerve of *Rana esculenta*) were used as indicators. The nerve was placed in a moist chamber consisting of two separate sections, one containing two platinum electrodes for stimulation with condenser discharges, the other two silver–silver chloride electrodes for leading-off action potentials. Care was taken to avoid stimulus escape and to provide constant resistance between the leading-off electrodes. Anoxia was produced by passing a moist stream of purified oxygen-free hydrogen through each section of the chamber.

When anoxia is applied to both the stimulated and the conducting region of the nerve fibre, the average time necessary to suppress activity is 34 minutes, while it takes more than 70 minutes when anoxia is limited to the leading-off section of the chamber. This difference is statistically highly significant. The action potential reappears immediately after readmission of oxygen with reduced amplitude and without a positive after-potential. After 15 minutes in oxygen it has regained its original shape and amplitude. The stimulated region of a peripheral nerve fibre is thus far more sensitive to anoxia than its purely conducting parts, a difference which might be of interest in the interpretation of the mechanisms of excitation and propagation.

A further discussion on the matter is to be published elsewhere.

FRITZ BUCHTHAL.
HELGE HERTZ.

Physiological Institute,
University of Lund.
Nov. 16.

Toxicity of Adrenaline

UNHEATED solutions of adrenaline quickly acquire a coloration if exposed to air or oxygen for a short period of time. Sodium or potassium metabisulphite has been proposed as an antioxidant for such solutions[1], and the U.S. Pharmacopeia XII permits the use of reducing agents such as sodium bisulphite up to concentrations of 0·5 per cent. The effect of this substance on the toxicity of adrenaline was investigated in the United States[2], and an increase of more than 100 per cent subcutaneously and more than three times intramuscularly was shown when tests were made on mammals. But no reference was made to the toxicity of adrenaline solutions containing metabisulphite after heat treatment, for example, autoclaving. These heated solutions, provided the *p*H is adjusted, have already been found to have lost very little activity, and to be sterile and colourless[1].

Solutions of adrenaline (1/1,000) in hydrochloric acid, with a final *p*H of about 3·0, were therefore prepared with and without 0·1 per cent of potassium metabisulphite, and their toxicities were tested on rats and frogs. The solutions containing metabisulphite were divided into two parts, and one was put in an ampoule and heated at 115° C. for 30 minutes. The rats were injected subcutaneously, the solutions containing 0·9 per cent sodium chloride; the frogs received their doses into the lymph sacs, the solutions containing 0·6 per cent sodium chloride. The approximate values for *LD* 50 (in mgm. per kgm.) were as follows: (*a*) rats—subcutaneously; adrenaline 12, adrenaline with metabisulphite 6, adrenaline with metabisulphite heated 14; (*b*) frogs—lymph sac; adrenaline 75, adrenaline with metabisulphite 30, adrenaline with metabisulphite heated 60.

Totals of sixty frogs (both sexes) and a hundred rats (all male) were used to obtain these values. These are relatively small numbers, but the results are important and more detailed work is in progress. Metabisulphite more than doubled the toxicity of adrenaline, thus confirming previous results[2]; but, on heating these solutions in 10-ml. ampoules, the tendency was to return to the toxicity figures of the plain solution. Other experiments have been carried out using metabisulphite solutions (0·1 per cent in 0·9 per cent sodium chloride), heated adrenaline solutions, and heated metabisulphite solutions, but no significant results were obtained.

G. B. WEST.

College of the Pharmaceutical Society,
London, W.C.1.
Nov. 16.

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Absolute Scotopic Sensitivity of the Eye in the Ultra-violet and in the Visible Spectrum

IN a paper published in 1941[1] measurements were given of scotopic and photopic sensitivity, for which nine observers were used. These measurements were made in the range between the mercury lines 709 and 302 mμ. In the paper by Goodeve, Lythgoe and Schneider published in 1942[2] measurements were given of scotopic sensitivity, for which six observers were used, including one with an aphakic eye. Their measurements were made at the mercury lines at 365 and 546 mμ. It is of interest to compare the results obtained after dark adaptation of one hour, with the results of Goodeve *et al.*, obtained after dark adaptation for 10 minutes.

The absolute scotopic sensitivity, S_λ, in terms of (quanta/sec. sq. mm.)$^{-1}$ is related to the illumination of the pupil, E_λ (the latter being expressed in terms of erg./sec. sq. cm.), by the equation

$$S_\lambda = \left[\frac{E_\lambda \times 10^{-2}\,(1-r)}{h\nu} \cdot \frac{\sigma}{a}\right]^{-1},$$

where r represents the reflexion losses at the cornea of the eye (assumed to be 0·05), σ the area of the pupil (assumed to be dark-adapted and equal to 50 mm.²), and a the area of the image on the retina in mm.². The area of the image a was 0·0088 mm.².

The accompanying table shows the comparison between our measurements of scotopic sensitivity and those of Goodeve *et al.*

	Observers and their age		log S_{365}		log S_{546}		log S_{546}/S_{365}	
	Pinegin	Goodeve *et al.*	Pinegin	Goodeve *et al.*	Pinegin	Goodeve *et al.*	Pinegin	Goodeve *et al.*
1st group	1 (17)	A (20)	−7·8	−7·5	−3·9	−4·1	+3·9	+3·4
	2 (19)	*E* (42)	−9·2	−9·8	−5·3	−5·0	+3·9	+4·8
	3 (15)	—	−8·4	—	−4·8	—	+3·6	—
	4 (19)	*B* (27)	−8·7	−8·8	—	−4·3	—	+4·5
2nd group	5 (37)	*D* (34)	−8·3	−8·3	−4·9	−4·4	+3·4	+3·9
	6 (22)	*C* (27)	−7·7	−7·7	−3·8	−4·2	+3·9	+3·5
	7 (25)	—	−8·6	—	−5·0	—	+3·6	—
	8 (21)	—	−7·9	—	−4·9	—	+3·0	—
	9 (29)	—	−7·8	—	−5·1	—	+2·7	—
	Mean values		−8·5	−9·2	−4·9	−4·5	+3·6	+4·7
		Mean values without *E*	—	−8·3	—	−4·3	—	+4·0
	Mean values for the first group		−8·8	—	−5·0	—	+3·8	—
	Mean values for the second group		−8·3	—	−4·8	—	+3·5	—
	—	*F* (26) (aphakic)	—	−4·2	—	−4·2	—	0·0

The absolute scotopic sensitivity in the ultra-violet was found to have greater individual variations, as some of the observers have maximum sensitivity at 334 mμ, and others have a flattening of the curve at 334–365 mμ. The value S_{365} for most observers in my investigations and in those by Goodeve *et al.* varies approximately in the same limits. Two of the observers in both cases have an equal sensitivity. But the mean value of S_{365} according to Goodeve *et al.* is considerably lower than the same value for the first and second group or for all the observers, in my case. If we exclude the data given by these authors for the eye with the lowest sensitivity, the mean value of S_{365} will be nearly the same for all my observers and equal to the mean value for the second group.

The mean value of S_{546}, according to Goodeve *et al.*, is 2·5 times my value. Therefore the threshold retinal illumination according to these authors was about 35,000, while according to my measurements it was about 85,000 quanta/sec. sq. mm.

This divergency can be explained by the difference in the area of the image on the retina (0·0088 mm.² in my case and 0·42 mm.² in the case of Goodeve *et al.*). Therefore the value of S_{546}, according to Gassovsky, Khokhlova and Bourago[3], must, in the case considered by Goodeve *et al.*, be twelve times my value. A considerable difference in adaptation could compensate for this divergency (up to 2·5 times). As a result, the mean value of the ratio S_{546}/S_{365} in our experiments was equal to 4,000, while in those by Goodeve *et al.* (excluding the observer with the lowest sensitivity) it was 10,000.

Thus the measurements of the scotopic sensitivity of the normal eye in the ultra-violet and in the visible spectrum, obtained by these authors, are in agreement with my results and fully confirm the latter.

The absolute scotopic sensitivity of the aphakic eye, according to Goodeve *et al.*, as could have been expected, was found to be the same at 365 mμ as at 546 mμ. This fact, in particular, confirms the measurements of the light fluctuation, made by S. I. Vavilov, including the presence of a maximum of retinal sensitivity at 3800 A.[4-11].

Goodeve *et al.* consider 309 mμ as the limit of vision of the normal eye and 298 mμ as that of an aphakic eye. Nevertheless, even at 302 mμ I was able to carry out the measurement not only of the scotopic, but also of the photopic, sensitivity of the normal eye.

N. I. PINEGIN.

State Optical Institute,
U.S.S.R.

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Large Contact Angles of Plant and Animal Surfaces

THE large values given by Fogg[1] for the contact angles of water with leaves suggest that these are apparent rather than true contact angles. Adam[2] and Wenzel[3] have shown that rough surfaces give an apparent contact angle which is greater than the true contact angle for the smooth material of the surface when the true contact angle is greater than 90°. We have recently extended this theory to porous surfaces[4], and to surfaces so rough that much air is entrapped at the interface between the water and the solid; large apparent contact angles are then possible when the true contact angle is even less than 90°. The apparent contact angle is given by

$$\cos \theta_D = f_1 \cos \theta - f_2, \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where θ_D is the apparent or observed contact angle, θ is the true angle, f_1 is the area of solid–water contact and f_2 is the area of air–water contact per unit superficial area of the interface.

The exposed surface of ducks' feathers has a ratio for f_2 to f_1 of around 5, and although the advancing contact angle for the material of the feather is no more than 90°, and the receding one 65°, the apparent angles are both around 150° because of the large value of $f_2 : f_1$. Thus, 'water always runs off a duck's back' because of the structure of the feather rather than because of an exceptional proofing agent.

The mirror-like reflexion of raindrops on leaves, particularly noticeable with broccoli leaves, must be due to total reflexion at an air layer between the

water and the continuous surface of the leaf. The degree of perfection of the mirror indicates that here, too, the ratio of f_2 to f_1 must be great, and the values of the observed contact angles will be largely determined by this ratio. The diurnal and wilting variations observed by Fogg are therefore more likely to be due to changes in the physical structure of the leaf cuticle with its water content than to changes in the material of the cuticle.

A. B. D. CASSIE.
S. BAXTER.

Wool Industries Research Association,
Torridon,
Leeds, 6.
Nov. 8.

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Presence in Raw Cow's Milk of a Bactericidal Substance Specific for Certain Strains of Coliform Organisms

DURING the course of an investigation as to the reason why certain strains of coliform organisms when inoculated into raw 'sterile' milk did not reduce methylene blue or resazurin, it was found that these organisms were actually destroyed in milk held at 37° C. for six hours[1]. As all the tests for the presence of a bacteriophage in the raw milk were negative, it was considered that the destruction of the organisms might be due to a specific bactericidal substance in the milk. The destruction of the organisms appeared to be closely correlated with the temperature at which the milk was held, so it was considered that the substance was probably not thermostable and further work was undertaken to find out the effect of heat on the substance. To do this, 'sterile' raw milk which had been heated to temperatures varying from 52° to 53° C. for half an hour was inoculated with young broth cultures of the susceptible strains of coliform organisms, so as to give an approximate inoculation count on MacConkey's agar of 500,000–2,000,000 organisms per ml.

Plate counts on MacConkey's agar were carried out at inoculation, and after holding the inoculated milk in a water-bath at 37° C. for four hours, with the following results:

Temperature to which milk was heated (for half an hour) before inoculation		Count per ml. at inoculation	Count per ml. after 4 hours at 37° C.
Culture No. 1	52° C.	1,328,000	1,000
	53° C.	848,000	40,000,000
Culture No. 2	52° C.	316,000	31,000
	53° C.	640,000	28,000,000

From these results it would appear that the bactericidal substance is completely destroyed by heating to 53° C. for half an hour, and that this destruction is critical to within 1° C.

All the cultures of susceptible coliform organisms were originally obtained from raw milk which the presumptive coliform test showed to contain coliform organisms in 1/1,000 ml. but which did not reduce methylene blue or resazurin after six hours incubation at 37° C.

The organisms were tested by the recognized differential tests to find if they conformed to any particular type, and the results of these tests showed that the majority of the organisms were intermediate types.

C. S. MORRIS.
Advisory Dairy Bacteriological Department,
Seale-Hayne Agricultural College,
Newton Abbot, Devon.

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'Marsh Spot' in Beans

THE condition known as 'marsh spot' in peas has been proved by Piper[1], using water cultures, to be due to manganese deficiency. An analogous condition in two varieties of broad beans (Wooster Mammoth and Jarvis) used for seed has been observed in the field in the United States by Orton and Henry[2], who suggested that it resembled 'marsh spot' in peas, and by Furneaux and Glasscock[3] in broad beans grown for seed on Romney Marsh. Similar symptoms in runner bean seeds submitted by a seed firm have been reported by Pethybridge[4], who suggested manganese deficiency as a possible cause, and by De Bruijn[5] at the Dutch Seed Testing Station in crops grown for seed.

During 1944, peas, *Pisum sativum* (var. Duplex), broad beans, *Vicia Faba* (var. Exhibition Longpod), runner beans, *Phaseolus multiflorus* (var. Scarlet Emperor) and French (dwarf) beans, *Phaseolus vulgaris* (var. Masterpiece), were grown at Long Ashton in manganese-deficient sand cultures, using a refined pot-culture technique, and the pods left on the plants until dry before harvesting. Examination of the seeds revealed typical severe 'marsh spot' in the peas, and mild to severe stages of a 'marsh spot' type of symptom in broad beans and runner beans, as illustrated; the middle of each cotyledon was sunken, brown and pithy, and the embryo in beans frequently showed browning of the plumule as noted by De Bruijn[6] in peas. The dwarf beans remained free from any signs of 'marsh spot'.

Typical leaf symptoms[6] (pale green, resembling a low nitrogen condition, with some faintly chlorotic mottling in runner beans and a more marked chlorotic mottling followed by severe intervenal necrosis and withering in dwarf bean) were developed, and

TYPICAL MARSH SPOT SYMPTOMS IN (ABOVE) RUNNER BEANS, (MIDDLE) BROAD BEANS, AND (BELOW) PEAS.

numerous pods failed to fill after setting. Broad beans, as with peas, normally show only a faint intervenal chlorosis of the leaves and the symptoms are not striking.

In a field trial in 1943, peas and broad beans (var. Exhibition Longpod) growing in an acutely manganese-deficient market garden soil in Bristol were examined and showed symptoms of the 'marsh spot' type in stages ranging from mild to severe. Similar material examined in 1944 showed severe 'marsh spot' in the peas and only mild symptoms of this trouble in the beans. Runner beans (Scarlet Emperor), dwarf beans (Prince and Masterpiece), a haricot bean (Comtesse de Chambord) and a tick bean included in the trial showed no symptoms in the cotyledons. The typical leaf symptoms were especially severe in the dwarf beans and in the haricot beans, in which the symptoms resemble those of the dwarf bean.

Leaf symptoms in these trials have been prevented and cured by spraying the leaves with an aqueous solution of manganous sulphate (0·25 per cent solution of $MnSO_4.4H_2O$). The results show that whereas peas are very susceptible to manganese deficiency, as shown by the severity of 'marsh spot', broad and runner beans are more resistant to this form of injury, whereas dwarf beans and haricot beans, which show the most marked leaf symptoms, are most resistant and may remain free from 'marsh spot' even when the leaf symptoms are very severe.

Some details of this and related work carried out under the Agricultural Research Council scheme for plant nutrition have already appeared, and a further report is in course of preparation[7].

I wish to make acknowledgments to the Agricultural Research Council for permission to publish this note and to Mr. G. H. Jones for taking the photograph.

ERIC J. HEWITT.

Long Ashton Research Station,
Bristol.
Nov. 9.

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Fluorescein-induced Parthenocarpy

PARTHENOCARPY can be induced in, among other plants, the common edible members of Solanaceæ and Cucurbitaceæ by artificial treatment of the unfertilized ovary with pollens of a different family[1], pollen extracts[2,3], many growth-promoting substances like indole-acetic acid[3,4], and even manganese salts[5]. All the inducing agents so far employed, including manganese salts, have been shown either to contain auxin or to be auxin-like in their physiological activities. These facts have led to the hypothesis proposed by Gustafson[3] that growth hormones are essential for the initiation and maintenance of fruit development, and recent experimental evidence seems to support this view[5]. While there is no doubt that growth hormones, defined as they are, play a dominant part in fruit development, it is still a question whether auxins or auxin-like substances alone can induce parthenocarpy; for we have been able to induce parthenocarpy in members of these two families with fluorescein, a substance known to act on plants sometimes antagonistically to auxins.

Left: PARTHENOCARPIC FRUIT. *Right:* NORMAL CUCUMBER.

During our investigations on the physiological activities of fluorescein dyes, we had applied a lanolin paste of 1 per cent fluorescein to stigma and cut styles of protected female flowers of cucumber. About half the treated pistils eventually developed into fruits which answered all the descriptions of parthenocarpy, being a little smaller in size and with a relatively large fleshy pericarp and empty ovules (see accompanying photograph). Similar smaller and seedless parthenocarpic fruits have been induced in *Luffa*, egg plant and pepper in subsequent trials. Time, however, does not permit a detailed study.

It has been known that roots which have been treated with eosin, one of the fluorescein dyes, lose their geotropic sensitivity and acquire phototropism instead[7]. This action of eosin has been explained by Skoog[8], who showed that traces of eosin cause rapid photodynamic inactivation of solutions of indole-acetic acid. When fluorescein was fed to plants at regular intervals, Sellei[9] was able to show that fluorescein at certain concentrations (0·5–3 per cent) dwarfs the plant, but at lower concentrations (1 : 2,000,000) promotes its growth and general development. The concentration we used for inducing parthenocarpy far exceeds those which will have beneficial effects on plants. Fluorescein is neutral in the *Avena* test and fails to induce local swelling in decapitated epicotyls of *Vicia*, as auxins and, strangely enough, some of the very common chemicals (for example, sugar) would do. Since Muir[6] has shown that the initiation of fruit development by pollen may be an indirect one, growth hormones being liberated from inactive combinations in the ovary after the pollen tube has been introduced, fluorescein dyes might do the same. We have in mind an analogous case in animal embryology, when certain dyes may uncover the inducing power of an embryonic tissue[10]. The plant used in our experiments is well known for its tendency to yield parthenocarpic fruits. It would be of great interest if similar experiments on parthenocarpy can be extended to other dyes, chemicals and even mechanical treatment.

CHIN-HSU LIU.
CHERNG-HOW LOU.

Physiological Laboratory,
Tsing Hua University,
Kunming.

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[6] Muir, *Amer. J. Bot.*, **29**, 716 (1942).
[7] Blum and Scott, *Plant Physiol.*, **8**, 525 (1933).
[8] Skoog, *J. Cell. Comp. Physiol.*, **7**, 227 (1935).
[9] Sellei, *Growth*, **4**, 145 (1940); **5**, 271 (1941).
[10] Needham, "Biochemistry and Morphogenesis" (Cambridge, 1942).

Linear Intercepts, Areas and Volumes

IN recent correspondence, Mr. P. A. P. Moran[1] has suggested a simple method of finding the surface area of small objects from their average area of projection. Another simple method of finding the surface area and also the volume of small objects is based on the measurement of their average linear intercept (mean chord). Some years ago, while working on the determination of the grain-size of rocks, I derived two formulæ and discovered two theorems related to the average linear intercepts. The formulæ can be applied to the calculation of the average grain-size in granular aggregates in which the sizes and the shapes of grains are the same. The theorems, so far as I can see, have a purely academic interest, although their application to granular aggregates may be attempted.

Enlarging on the conclusions arrived at by M. W. Crofton[2] for convex figures, the two formulæ are derived as follows: (1) In a plane convex figure (polygon, circle) the average length of projection is equal to the perimeter divided by π, and the average linear intercept (l) is equal to the area divided by the average length of projection:

$$l = \frac{\pi \times \text{area}}{\text{perimeter}}.$$

(2) In a three-dimensional convex figure (polyhedron, sphere) the average area of projection is equal to the surface area divided by four, and the average linear intercept is equal to the volume divided by the average area of projection:

$$l = \frac{4 \times \text{volume}}{\text{surface area}}.$$

As particular cases of these formulæ we have the following theorems:

1. The average linear intercept of a convex polygon circumscribed by a circle is equal to the average linear intercept of the circle.

2. The average linear intercept of a convex polyhedron circumscribed by a sphere is equal to the average linear intercept of the sphere.

In conclusion I would like to express my thanks to Dr. H. P. Mulholland and Dr. G. R. Goldsbrough, for their help in this matter.

S. I. TOMKEIEFF.

King's College,
Newcastle upon Tyne.

[1] *Nature*, **154**, 490 (1944).
[2] Crofton, M. W., *Proc. London Math. Soc.*, **8**, 304 (1877).

Amplitude Effect in Cepheid Variables

IN the interesting review[1] of the pulsation theory in his George Darwin Lecture of 1943 before the Royal Astronomical Society, Prof. S. Rosseland has indicated the importance of unharmonic oscillations in explaining the Cepheid characteristics, and brought out the effect of the amplitude in lengthening the pulsational period, pointed out by Kluyver[2] in 1937, and imparting the characteristic skewness to the light and velocity curve.

In the special case, when the amplitude is of the order of a fourth of the radius, the star being composed of a homogeneous monatomic gas, on neglecting the overtone effect, and taking account of the self-coupling term for the fundamental up to the third order only, Prof. Rosseland mentions a lengthening of period in the ratio 1·7 : 1, and a rise to the maximum four times faster than the decline to the minimum. While there is a considerable discrepancy to be bridged, these results should be taken as good indication of the amplitude effect.

For general values of the adiabatic index, it is, of course, imperative to take resort to approximations, even with a predominant self-coupling term; but for homogeneous monatomic gases, a complete solution for the fundamental can be obtained. One of the integrals of motion, since the time is not explicitly present in the Hamiltonian, is

$$H = K + U + V = \text{const.},$$

K, U, V being the kinetic, thermal and potential energy of the star. Neglecting the overtone velocity term in K, and the inter-coupling terms in U and V, the equation for the time coefficient can be solved without approximation, and it is found that assuming η to be the proportionate amplitude of pulsation, the time coefficient varies between the limits 1 and $(1 + 2\eta)^{-1}$. For $\eta = 1/3$, this gives 1 and $-0{\cdot}6$; the corresponding values given by the third order approximation are 1 and $-0{\cdot}5$. This is close enough, but at the same time the value $-0{\cdot}6$ indicates a further increase in the discrepancy with the observed values.

The pulsational period in terms of that for the harmonic period is $\dfrac{T_{\text{anharmonic}}}{T_{\text{harmonic}}} = \dfrac{(1+\eta)^3}{(1+2\eta)^{3/2}}$, while the speed of increase of the velocity curve to maximum over the decline to the minimum is given by the ratio

$$\frac{\text{Time of decline}}{\text{Time of rise}} = \frac{\pi - \cos^{-1}\left(\dfrac{\eta}{(1+\eta)}\right) + \dfrac{\eta\sqrt{1+2\eta}}{(1+\eta)^2}}{\cos^{-1}\left(\dfrac{\eta}{1+\eta}\right) - \dfrac{\eta\sqrt{1+2\eta}}{(1+\eta)^2}}$$

These give a steady lengthening of the period from the value for the harmonic oscillation to a value 1·56 times as great. The skewness of the velocity curve increases as η varies from 0 to 1; during this time the speed ratio increases only from 1 to 4·12. For $\eta = \frac{1}{3}$ these ratios are 1·20 and 1·92, while Prof. Rosseland's values are 1·70 and 4 approximately. The details of the calculations will be given elsewhere.

Thus the fitting to the observed values achieved for the rather large value $\eta = \frac{1}{3}$ even vanishes, and the discrepancy which Prof. Rosseland rightly points out appears to be considerably greater than he thinks. For values of η of the order of the observed values, the anharmonic oscillation curves would be almost indistinguishable from the harmonic case.

We therefore think that the amplitude effect is a contributory cause to the Cepheid characteristics, and probably not a dominant cause; and factors such as the decrease in the central condensation[3,4] must be brought in for a complete explanation of the Cepheid phenomenon.

SUNIL KUMAR ROY.

Mathematics Department,
University, Allahabad.

[1] Rosseland, S., *Mon. Not. Roy. Ast. Soc.*, **103**, 233 (1943).
[2] Kluyver, H. A., *B.A.N.*, **7**, 265 (1937).
[3] Miller, J. C. P., *Mon. Not. Roy. Ast. Soc.*, **90**, 59 (1929).
[4] Kopal, Z., *Mon. Not. Roy. Ast. Soc.*, **99**, 33 (1939).

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL CONFERENCE

THE nineteenth annual conference of the Association of Special Libraries and Information Bureaux, held in the rooms of the Royal Society on December 9 and 10, 1944, was one of the best attended conferences of the Association, and most of the sessions were characterized by animated discussions which indicated a live interest on the part of the general body of members.

In his opening presidential address, on "Organized Knowledge in the World of the Future", Sir Frederic Kenyon, after congratulating the Association on its achievements, said that the *raison d'être* of ASLIB is the service of humanity by the organized supply of knowledge. While the service of industry is its first and most obvious activity, he believes that knowledge must not be restricted to such utilitarian application but applied in the most liberal spirit to the whole of our national life. We cannot rest satisfied with the lack of appreciation of the knowledge, the skill and the inventiveness to be found in British science and scholarship and with the failure to apply them. The practical value of scientific research can no longer be denied and Sir Frederic hopes that we shall not grudge expenditure on free disinterested studies. While, however, it is right that we should try to make this knowledge readily available for those who are able to use it, that alone is not enough. Knowledge can be curse as well as blessing, and Sir Frederic urged that knowledge must be not merely organized but also its use controlled by principles of higher validity than material power. Knowledge is good, but its value is related to something higher still which Plato called the idea of good, and which Bacon called God. Sir Frederic believes that the welfare of the nation and of the world at large depends on a change of soul and a change of living, which can only be effected by a change of principle from competition to co-operation, from organization to morality or religion. The organization of knowledge must be harnessed to moral standards if strength and wisdom are to be brought together.

The first session of the Conference was devoted to a particular aspect of this co-operation, "The Empire Contribution to the Flow of World Information", and Prof. R. S. Hutton presided. As a basis for discussion, members of the Conference had before them nine papers describing various specialized sources of information on and within the British Empire; those of Mr. R. L. Sheppard, Mr. Kenneth Binns, Mr. G. B. Gresford and Mr. A. L. Poole were presented in person. Some notes on the India House Library were also available at the Conference. Sir Harry Lindsay described the work of the Imperial Institute as a special library and information bureau. Sir David Chadwick outlined the work of the twelve Imperial Agricultural Bureaux. Mr. Sheppard described the development and work of the Bureau of Hygiene and Tropical Diseases from the Sleeping Sickness Bureau which commenced work on June 1, 1908, in a room at the Royal Society. The Bureau is now responsible for the issue of the *Tropical Diseases Bulletin*, the *Bulletin of Hygiene* and the *Bulletin of War Medicine*, and surveys for this purpose some 650 English and foreign medical and scientific periodicals. The abstracting is done by a panel of more than two hundred contributors specially associated with the subjects they review, and Mr. Sheppard emphasized the critical character of the abstracts issued.

A note on the Library of the Royal Empire Society in 1944 was contributed by Mr. Evans Lewin, who described its work more fully at the 1933 Conference. The note included a select list of periodical publications received in the Library; and a list of sources of Canadian bibliographical information was forwarded by Mr. C. R. Sanderson, chief librarian of the Public Library of Toronto, among which the Canadian catalogue of books published in Canada, about Canada, as well as those written by Canadians, was singled out for mention by Prof. Hutton. This has been published annually since 1923 by the Toronto Public Libraries.

The flow of information between Britain and Australia was discussed by Mr. Binns, who stated that a second edition of "Pitt's Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia" is in preparation, and that a similar work on the social sciences is planned by the National Library. The National Library has also issued annually, since 1936, a fairly complete list of publications appearing in the Commonwealth or touching Australia; and this, and a Select List of Representative Works dealing with Australia, issued annually since 1934, has been freely available to overseas libraries and institutions on an exchange basis. The Australian National Research Council also publishes *Australian Science Abstracts*; but in reply to a question, Mr. Binns admitted that this has a very limited circulation. He also referred to the establishment this year at Australia House, London, of an Australian Library of Information as an activity of the National Library at Canberra. A further paper, "Notes on Library and Information Services in Australia", presented by Mr. G. B. Gresford, emphasized the value of "Pitt's Catalogue of Scientific and Technical Periodicals in Australian Libraries", and also referred to the Scientific Liaison Bureau set up in 1942 by the Commonwealth Government and to the Information Section maintained by the Council for Scientific and Industrial Research. In concluding, he referred to the two schools of thought in Australia with regard to the publication of scientific research, and invited opinion as to the desirability or otherwise of publication in Australian periodicals or overseas. In response to this invitation, it was urged during the discussion that a policy of publication in the established British and American periodicals, such as the *Journal of the Chemical Society* and the *Journal of the American Chemical Society*, should be followed, and efforts made to avoid the multiplication of periodicals the circulation of which could only be limited.

In a further paper, Mr. A. L. Poole contributed some notes on the organization of scientific research in New Zealand with a list of sources of bibliographical information on New Zealand, while the final paper in the symposium, communicated by Mr. P. Freer, on "Bibliographical Work in South Africa", in addition to enumerating the chief guides to recent literature of the Union, made a number of suggestions for improvement of co-operation, some of which were taken up in the ensuing discussion. Among these suggestions were the improvement of book supply centres in South Africa, possibly inter-allied book centres in co-operation with the British Council,

co-operative cataloguing, reprinting of important books now out of print and the exchange of staff between the National Central Library and the Dominion State libraries. Very little tangible result emerged from the discussion, though there was clearly support in general for further co-operation in various directions, including abstracting, between English-speaking countries. No evidence was supplied that much progress has been made as yet on the lines indicated in the report of the British Commonwealth Science Committee, but some reference was made to Dr. Needham's more recent proposals (see *Nature*, November 25, pp. 649, 657).

The second session of the Conference was devoted to a paper on "Trade Catalogues in the Commercial Library", by Mr. G. K. Wilkie, who briefly described the collection of such catalogues in the Leicester Municipal Libraries, indicating its value as a source of technical information, the way in which the collection was formed and the method of making it available to the public. He favours the vertical file system of housing, and stressed the importance of having the right person in charge of any such collection.

Past conferences of the Association have frequently suffered from the attempt to cram two papers into a session barely adequate for the discussion of one, and of this the third session was an unhappy example. Mr. E. Carter's able chairmanship could not avoid an untimely termination of the discussions stimulated by Mr. G. A. Shires' paper, "The Technical Information Bulletin and what to put in it", and Mrs. Moholy's report on microfilm developments. Mr. Shires outlined the general policy on which the service offered was based, as shown in the issue of such a bulletin in the Dunlop Rubber Company. He aroused lively curiosity as to the means by which he secured the efficient production of abstracts from specialist members of the technical staff; but only the barest discussion of the material aspect or of the principles followed in the selection and presentation of material was possible. Mrs. Lucia Moholy presented her report on "Developments and Extensions in the Uses of Microfilm". This paper covered the period since her report to the Association's Conference in November 1942. The day-to-day activities of the ASLIB microfilm service include the recording in detail of every strip of film of which a master negative is retained, catalogue entries with all available particulars which serve as a basis for the acquisition of new items, and the development of special filing arrangements. Co-operation with Government departments and special libraries has enabled the service to be extended far beyond the original scope of a technical unit. Dr. Moholy visualizes two main tasks for documentary reproduction in the projects of an international clearing house of library services and for scientific co-operation: the interchange of complete books, periodicals and other publications on microfilm, and the supply of articles from periodicals, excerpts from books and other selected items for specialized research on film strips, in microprint or photostat copies as required. Documentary reproduction would be of special importance in co-operation with an international research service as a technical section covering all branches of learning—the sciences and the humanities.

An adequate supply of reading machines is still lacking, and Dr. Moholy does not think that the failure to meet the demand can be justified merely by war-time difficulties. First-class microfilm readers are still manufactured in the United States; but the supply is restricted to those who can obtain the necessary permits and high priority. Recently, a microfilm viewer has been designed in the United States for a special purpose. This reader, which was exhibited at the Conference, folds into a flat box 5 in. by 2 in. and weighs less than 2 oz. It is useful for looking up references and may in emergency serve for reading a few pages, but is not suited for research purposes. Reference was also made to the recommendations on filing and storing microfilm issued this year by the British Standards Institution (B.S. 1153—1944), and to the possibilities of microprint as recently emphasized by Fremont Rider in his book "The Scholar and the Future of the Research Library" (see *Nature*, November 25, p. 655). Mrs. Moholy pointed out that microprint is only justifiable for a considerable number of copies and is thus on an equal footing with printed matter and subject to copyright. If the technique of microprinting is adopted in Great Britain, a similar or supplementary agreement like the draft agreement on microfilm issued by the Publishers' Association in co-operation with the Society of Authors, and in consultation with the Association of Special Libraries and Information Bureaux, and published in the *Bookseller* of July 7, 1944, would be required. Mrs. Moholy's report, and the subsequent discussion, indicated a more sober view of microfilm and of its limitations than formerly prevailed, and that it must be regarded as supplementary, not replacing, other means, such as photostats.

The next session of the Conference, over which Mr. C. le Maistre presided, considered a paper by Mr. E. R. McColvin on "The Education and Status of Special Librarians", which was based on the answers to a questionnaire circulated to members of the Association, chiefly on the replies received from research organizations, industrial or commercial organizations and Government departments. Mr. McColvin emphasized that organization would be better and more efficient the fewer the dead-end positions at any level to be found in it. His analysis of the requirements of both junior and senior staff led him to outline syllabuses suggested by the ASLIB Education Committee. This paper was followed by one by Miss Ruth S. Leonard on the recruitment and training of special librarians to fit the present and future needs of the special library profession in the United States. Throughout the animated discussion on these two papers, there was a pronounced cleavage of opinion, as was also evident in the voting on a resolution in favour of the question being taken up by the Association. It is difficult to see that any substantial advance has been made since the question was last debated at the Association's Conference of 1935.

At the final session, when Sir Hugh Beaver presided, Mr. A. B. Agard Evans presented a paper on "Some Aspects of a new Technical Information Service in War-time", in which he discussed such problems against the background of the experience of the Records Section of the Research and Experiments Department of the Ministry of Home Security. This Records Section was part of the initial organization of the Department which came into being in February 1939 under the chief adviser, Dr. R. E. Stradling, then director of building research under the Department of Scientific and Industrial Research. Collaboration of the records officers of the three Service departments, other Government departments and of technical institutions was secured, and the

A.R.P. Department and the Building Research Station in particular provided a valuable nucleus of technical information, and the Civil Defence Research Committee established in May 1939 was a further focus. Mr. Evans also referred to the generous help of the Patent Office Library, the Science Museum Library, the British Library of Political and Economic Science and the Royal Institute of British Architects. To the main subjects originally covered, such as H.E. and incendiary bombs, blast, ballistics, fragmentation and penetration, building and strength of materials, were soon added others such as lighting and black-out, physiological and psychological effects, camouflage and paint, window protection, location of industry and population. In regard to shelving, Mr. Evans stated that, as in other stations of the Department of Scientific and Industrial Research, books are shelved under broad subject headings, pamphlets by country and institution, periodicals alphabetically by title. In regard to book buying, he suggested that it would be of great value to librarians if publishers would set up a joint central library of new technical books where they could be inspected with the view of purchasing through the usual channels. Mr. Evans also commented on the limitations of microfilm, and appeared to lean rather to a photostat, urging strongly the termination of the system of loaning heavy bound periodicals and substituting a photostat or microfilm copy of the article required.

STUDIES OF THE AMARYLLIDACEÆ

HERBERTIA, the year-book of the American Amaryllis Society, has now reached its tenth volume (from L. S. Hannibal, Concord, California, July 1944). This publication maintains its potent blend of science with practice. It employs fertility in number of its titles with economical expression in its individual papers, to achieve a wide review of all questions which affect the horticulture of Amaryllids. Many facets are discussed—personal, historical, and cultural. In the sections on classification, genetics, the physiology of reproduction, and pathology, several interesting facts appear.

Dr. Hamilton P. Traub, editor of *Herbertia*, has published an account of the tribe Brunsvigieæ, which, it is proposed, should now include the genera *Crinum*, *Brunsvigia*, *Buphone*, *Nerine*, *Ammocharis* and *Cybistetes*. A new genus, *Worsleya*, has been proposed to separate the single species *W. procera* from the genus *Amaryllis*, with which it has no gene exchange, and from which it differs in several morphological characters. The genera *Agapanthus* and *Tulbaghia* are border-line genera between Amaryllidaceæ and Liliaceæ, now included in the former group. J. C. Th. Uphof reviews the present position of the two genera, and describes the species included in each. As a background for taxonomic studies, W. S. Flory, jun., reports the chromosome numbers for various species of Hemerocallideæ, Alstroemeriales and Amaryllidales which have been published since his earlier review in 1937.

Gardeners and students will be interested in a brief article by Kenyon L. Reynolds outlining the method for cross-pollinating Narcissi. This involves the ripening of pollen in a desiccator. V. T. Stoutemyer and Albert Close also discuss the latter question, suggesting the trial of freezing temperatures and definite humidities for storing pollen, and the use of mixed pollen, hormones, and other substances for overcoming certain types of sterility. Their paper is, however, a wider review of the whole question of reproduction. Many seeds of Amaryllids germinate without a rest period, while others have a more or less protracted time of dormancy. Seeds of *Hymenocallis occidentalis* have an integument capable of photosynthesis, which appears to accelerate germination, though development can take place more slowly in the dark. It is interesting to note that vegetative propagation by scoring or cutting the base of the bulb is being employed more extensively in the Amaryllidaceæ. John V. Watkins adds a further note on the use of this method for *Lycoris aurea*.

L. S. Hannibal records the lesser bulb fly as a pest on several Amaryllids other than Narcissus. *Lycoris squamigera* and *Hæmanthus multiflora* appear to be even more heavily attacked than members of the genus *Narcissus*.

The natural order under discussion, however, seems to have but little acquaintance with pest or disease, and this factor should be added to that of superb garden beauty to inspire an even wider horticultural use of this interesting group.

NEW WOODS FOR CROSS-ARMS FOR TELEGRAPH LINES

AN article by G. Q. Lumsden (*Bell Lab. Rec.*, 22, No. 14 ; October 1944) discusses new woods for cross-arms and their preservation. Since the turn of the century, the open-wire lines of the Bell System (U.S.A.) have been carried mostly on Douglas fir and southern pine cross-arms. War emergency demands for these timbers have made it necessary, however, to seek substitutes, and the woods most readily available were red and jack pine from the Lake States and the inland type of Douglas fir from the north-west.

In testing out these alternatives it was decided to apply a preservative treatment to the new arms by an improved hot-and-cold bath process, instead of using the standard pressure processes regularly employed for southern pine arms. A solution of pentachlorphenol in petroleum was used instead of creosote for the cold bath. Pentachlorphenol is a comparatively new wood preservative, being practically soluble in water and leaving the surface of the wood clean.

About 1,100 cross-arms were treated at a time. These were laid in a tank and kept from floating by steel rails secured to the tank sides. Heavy lids were put on to hold heat, prevent excessive evaporation and keep out rain. The hot-and-cold bath non-pressure treatment was then applied. Creosote, heated to above 220° F., was pumped in to fill the tank. From two to four hours later, depending on the condition of the timber treated and the outside temperature, this creosote was pumped off. As soon as possible, and while the cross-arms were still hot, the tank was filled with a 5 per cent solution of pentachlorphenol in an aromatic petroleum at 90–125° F. After allowing another two to four hours for this solution to be absorbed, the tank was again drained and the cross-arms removed for stacking.

At the end of the cold-bath treatment, the sapwood was completely penetrated and the heartwood was penetrated around the pinholes. Retention of preservative solution varied with the amount of sapwoo..

present, averaging about 8·5, 6·4, 0·6 lb. of solution per cubic foot of wood for red pine, jack pine and heartwood inland fir, respectively, in the sections between pinholes.

The treated arms were stacked for curing by a method recently devised by the Bell Laboratories to keep end checking, splitting and warping to a practical minimum. They were laid on a sturdy foundation of 8 in. by 8 in. timbers with their ends well protected by overlapping alternate tiers. After curing, part of the arms were X-piled, to determine their tendencies, if any, to bleed, warp and split.

Breaking tests on sample arms indicated that inland fir is practically as strong as the current standard coast-type fir and southern pine arms, and that red and jack pine are about 80 per cent as strong.

Successful non-pressure treatment of red pine, jack pine and inland fir cross-arms with hot creosote, followed by cold pentachlorphenol dissolved in a suitable petroleum, opens new avenues of relief in a restricted lumber field. Other woods may be used provided they are strong enough and will take preservative treatment. For example, ponderosa pine, western hemlock and larch are all worth considering, if the supply situation warrants it. On the basis of work already done, the Bell Laboratories recommend the more promising substitute woods for cross-arms, and standard specifications have already been revised to include red pine, jack pine, lodgepole pine and inland fir.

FORTHCOMING EVENTS

Saturday, January 6

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Harold Spencer Jones, F.R.S.: "Astronomy in our Daily Life", 5: "Clocks and Time Keeping" (Christmas Lectures).

Monday, January 8

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—The Rt. Hon. the Earl De La Warr: "British Agriculture and World Conditions".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, South Kensington, London, S.W.7), at 5 p.m.—"The Burmese Scene" (Recent Kodachrome Films with Commentary by U. Myat Tun).

INSTITUTE OF FUEL (NORTH-EASTERN SECTION) (at the Central Station Hotel, Newcastle-upon-Tyne), at 5.15 p.m.—Prof. H. L. Riley, Mr. J. Blaydon and Mr. H. E. Gibson: "The Molecular Nature of Coking Coal Bitumens".

Tuesday, January 9

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Harold Spencer Jones, F.R.S.: "Astronomy in our Daily Life", 6: "Finding Position at Sea and in the Air" (Christmas Lectures).

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 5.30 p.m.—Mr. R. Gillespie Williams: "The Poetry of Light".

INSTITUTION OF CIVIL ENGINEERS (ROAD ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5.30 p.m.—Discussion on "Lay-out of Road Intersections" (to be opened by Mr. A. J. H. Clayton).

Wednesday, January 10

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. R. Critchley: "How Wrecked and Sunken Ships are Salved" (Dr. Mann Juvenile Lecture).

INSTITUTE OF FUEL (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Sir Alfred Egerton, F.R.S., and Mr. Malcolm Pearce: "Methane".

INSTITUTE OF PETROLEUM (at 26 Portland Place, London, W.1), at 4.30 p.m.—Dr. G. B. B. M. Sutherland and Dr. H. W. Thompson: "Spectrographic Methods Applied to the Petroleum Industry".

Friday, January 12

INSTITUTION OF MECHANICAL ENGINEERS (in conjunction with the APPLIED MECHANICS GROUP) (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. A. Fogg: "Fluid Film Lubrication of Parallel Thrust Surfaces"; Dr. D. Clayton: "An Exploratory Study of Oil Grooves in Plain Bearings".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. H. O. Walker: "Notes on the Buchi System".

Friday, January 12—Saturday, January 13

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (DIVISION FOR SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE) (at the Royal Institution, Albemarle Street, Piccadilly, London, W.1).—Conference on "The Place of Science in Industry" (to be opened by Sir Richard Gregory, Bart., F.R.S.)

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

MECHANICAL ENGINEER by the Government of British Honduras for the Public Works Department—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. C.2406.A) (January 10).

LECTURER (full-time) IN THE DEPARTMENT OF CHEMISTRY—The Principal, Derby Technical College, Normanton Road, Derby (January 10).

ASSISTANT CHIEF CHEMIST (essential qualifications are supervision and direction of Laboratory Staff engaged in investigational work and routine testing of production samples in entomological, physical, organic and colloidal chemistry, with particular reference to detergents and emulsification) for a permanent superannuable appointment in Yorkshire—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.3039.XA) (January 10).

ASSISTANT TO THE ADVISORY OFFICER IN ANIMAL HUSBANDRY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (January 10).

EDUCATIONAL PSYCHOLOGIST—The Director of Education, County Offices, Oxford (January 15).

METALLURGIST (must hold a University degree in Metallurgy and be well versed in the Metallography and Heat Treatment of Alloy Steels and Aluminium Alloys) by progressive firm on the South Coast—The Ministry of Labour and National Service, Central Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.2363.XA) (January 16).

RESEARCH ASSISTANT (male) in the Agricultural Entomology Division of the Ministry of Agriculture—The Assistant Secretary (Establishments), Ministry of Finance, Stormont, Belfast (January 16).

SENIOR POST as RUBBER RESEARCH CHEMIST with a large Company in the North of England engaged in rubber manufacture—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.3360.XA) (January 17).

TEACHER (full-time) OF ENGINEERING SUBJECTS for senior and junior students in the Northampton College of Technology—The Secretary for Education, Borough Education Office, Springfield, Cliftonville, Northampton (January 20).

LECTURER IN THE MECHANICAL AND CIVIL ENGINEERING DEPARTMENT of the Sunderland Technical College—The Director of Education, Education Office, 15 John Street, Sunderland (January 20).

HEAD OF THE SCIENCE DEPARTMENT of the Blackburn Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn (January 20).

HEAD OF THE PHYSICS DEPARTMENT—The Principal, Derby Technical College, Normanton Road, Derby (January 22).

REGIUS CHAIR OF ANATOMY at Glasgow University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (February 24).

DIRECTOR OF MUSEUMS—The Town Clerk, Municipal Buildings, Dale Street, Liverpool 2 (February 28).

LABORATORY STEWARD IN THE DEPARTMENT OF PATHOLOGY—The Secretary and Registrar, The University, Bristol.

DEPUTY ASSISTANT RADIUM CUSTODIAN (female) in the Radium Department—The Clerk to the Governors, St. Bartholomew's Hospital, London, E.C.1.

GRADUATE ASSISTANT MASTER qualified to teach MATHEMATICS, SCIENCE and ENGINEERING DRAWING in the Junior Technical School and National Certificate Classes in the Ashton-under-Lyne Technical School—The Director of Education, 8 Warrington Street, Ashton-under-Lyne, Lancs.

TEACHER OF BIOLOGY who can also offer service in CHEMISTRY and/or PHYSICS, and a TEACHER (full-time) IN THE MATHEMATICS AND PHYSICS DEPARTMENT—The Principal, Municipal Technical College, Hopwood Lane, Halifax.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

British Rubber Producers' Research Association. Publication No. 53: Distribution of Oxygen in Oxidised Rubbers. By R. F. Naylor. Pp. 10. Publication No. 54: The Interaction between Rubber and Liquids. Part 5: The Osmotic Pressures of Polymer Solutions in Mixed Solvents; Part 6: Swelling and Solubility in Mixed Liquids. By G. Gee. Pp. 18. (London: British Rubber Producers' Research Association.) [2112

Hope for the North-East. Pp. 16. (Newcastle-upon-Tyne: Association of Scientific Workers.) 3*d*. [2812

Catalogue

Annotated Catalogue of Works on Physics, including also Items on Collateral Sciences, and comprising the Library of Prof. John Tyndall. (No. 873.) Pp. 88. (London: Henry Sotheran, Ltd.)