of enzyme carrier systems which recall earlier suggestions made on the same topic by Stern.[28]

The high lipid content of the mitochondria and particulates calls for some comment. Dry mitochondria contain about 34 per cent. of lipids; dry particulates as high as 51 per cent. Both figures are much higher than the average content of the whole cell. Therefore other portions of the cell contain much less than the average. Recent quantitative studies of this distribution reveal that structural proteins and particulates in the liver together carry about 90 per cent. of the total dispersed lipids and as high as 98 per cent. of the phospholipids. These determinations must be made on cells without an oil phase. Plasmosin contains when purified little fat, about 4 per cent., the ellipsin residue about 25 per cent. Thus, in the liver the interparticulate liquid contains little disperse fat and almost no phospholipid. These substances are largely contained in these little packets which I have called particulates and bound in the membranous and fibrous portion of the cell.

On the other hand, the interparticulate portion of the cytoplasm contains much protein, probably for the most part of the corpuscular or globular type. It also contains some flavoproteins but does not oxidize succinate, indicating that some essential member of the succinoxidase chain is missing. I do not know what the content of Wyckoff's macromolecular substances is or where they fit into this conception of protoplasm.

The fat distribution in mitochondria and in particulates does not differ in any important respect from that of the whole cell. Our previous estimates of lecithin were too low owing to the use of the unreliable acetone precipitation method. Phospholipid estimated as lecithin from phosphorus determinations show a content of lecithin of 45 to 58 per cent. of the total lipids. A positive Schiff reaction indicates a content of acetal phosphatid. The distribution as to lecithin kephalin and sphingomyelin has not been determined. We have not yet determined the inorganic constituents of the particulates.

Cytoplasm thus has no ultimate structural unit but consists instead of several perhaps many different types of units, all cooperating in an orderly fashion to produce that ensemble of properties which we call life. At the present time our knowledge is very incomplete but we can recognize the following categories:

(1) Those units upon which the integrity of the cell as a unit of structure, the maintenance of its organization, and those properties enumerated by Seifriz, depend. In these units the fibrous proteins and nucleoproteins with associated lipids, etc., described play an important role.

(2) Particulates, microscopic and submicroscopic, of highly complex composition mediating special chemical processes.

(3) The interparticulate liquid menstruum also of complex composition but at present little understood.

The methods and quantitative results upon which the foregoing statements are based will be published elsewhere in collaboration with Dr. Lazarow, who for several years has assisted me in the work.

Obviously the possibility of separating mitochondria and particulates and of isolating the structural proteins for chemical study opens up a rich field for further research. The localization of enzyme and carrier systems, vitamins and hormones, and the viruses, functional changes in composition, the tracing of radioactive isotopes into the interior of the cell and the further fractionation of the submicroscopic particles by more refined methods all offer inviting opportunities to the inquiring mind.

It is a pleasure to acknowledge that my work has been much helped by the loyal and generous attitude of my colleagues and former students in the Department of Anatomy and by the generous contribution of funds from the Rockefeller grant and from the Wallace C. and Clara A. Abbott Memorial Fund of the University of Chicago.

It is a pleasure also to reflect that the funds at my disposal have never been large enough to tempt me to abandon investigation for direction of others, and thus to miss in these years of retirement the joys that come, in fullest measure, only to those who satisfy their desire for knowledge by a direct and personal appeal to nature by research.

WARTIME MAINTENANCE OF SCIENTIFIC PRODUCTION

By Dr. J. S. NICHOLAS
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MANY theses have been founded on the relationship of supply and demand. When the President made his wartime demands on industry, few thought that the stated objectives could be attained. Although in some cases there has not been complete attainment, in the majority and dominant aspects of the program

[28] K. G. Stern, *Symposia on Quantitative Biology*, Cold Spring Harbor, 7: 312, 1939.

there has been generally an increase in production beyond all expectation—in some cases greatly exceeding the amount for which the President asked.

There are brightening aspects of production. With typical American spirit we have taken regard of the impossible and have proved it possible. Output has been speeded; the number of man-power hours necessary for each operation has been decreased. Technical details of model changes and modification have been met with a just perceptible ripple in the flow of output. Material supplies have literally been created either by substitution of more accessible products or the more efficient handling of old ones. In industry, both production and supply have worked miracles.

The academic production, however, has suffered by contrast with the industrial. The demands upon industry have been proportionately small compared with those presented to the academic circle. Industry was faced with an immediately crystallized objective and the operations incident to its realization could be clearly sketched and evaluated. Its needs were recognized and men were detailed either from other less essential plants or from our colleges to make these operations practicable. Conditions within the universities were not so simple, for various reasons.

In the first place, the armed services had for some time been able to develop little in the lines of research incident to the utilization of equipment of modern warfare. Present survey shows that the Army had plans for modernized combat units, but these were paper plans constructed in the main without the benefit of practice and observation necessary for the perfection of practical organized tactical combat units.

In order to utilize the new appliances which were to be employed against an enemy with years of practice in the field, there resulted immediately an exceedingly concentrated call upon academic resources for practical research strictly applied to the combat mechanics of new apparatus. This naturally necessitated short cuts of all types, and the staff and student body of our universities have contributed much toward the rapid organization and rapid advances along these lines.

The question of demand brought about a situation which our colleges and universities were more unprepared to face than had been the army with reference to mechanized warfare. Most academic staffs had been built up over a period of years with the idea of maximum teaching load and but a small proportion of time had been designated for research. However, a few more public-spirited institutions, which had been far-sighted enough to allot to research and development a larger share, were immediately available for the government's call and their staffs have formed the backbone of research in the transfer from the needs of peace to the necessities for war. This change of emphasis involved the total effort of some of our science departments, with, in some cases, a complete demolition of what had been a useful academic team.

The fact that we are participating in total war which demands total effort can not be overemphasized. The total effort of academic groups has so far been harnessed in only a desultory fashion. Research men have been called into the services or into governmental organizations without thought for the future. No replacements exist in some fields for the men who have been withdrawn to necessary and urgent work, either in industry, governmental research or armed services.

No advanced planning could have foreseen the extent of our academic involvement but now the time has come when the allocation of certain groups of personnel must be accomplished as ruthlessly as is the work of the local tire rationing boards. This is peculiarly so in highly specialized and trained groups in which we have a sharply limited supply. Some of these supplies have reached a level so low that replacement production is seriously impeded. In the academic field we have been muddling through so far by changing the working load, by accelerating schedules and eliminating vacation time. This would considerably increase output if we retained an adequate staff on the academic production line, but this it has been impossible to maintain.

The fields from which the greatest amount of research personnel has been removed for war effort are those which now have the greatest teaching load in production. Specifically, the shortages are greatest in physics and mathematics, which are focal points of emphasis in the new armed forces' program now rapidly becoming installed in our colleges and universities. The enrolments in these fields, particularly during the immediate future, will be far greater than even a full peacetime staff could handle, for many students in upper classes will, by the service regulation, be compelled to complete this training. Depletion of the staff by the part-time or full-time participation in other war activities must be recognized as a fact. We must produce substitutes in these fields just as energetically as we would produce a rubber substitute.

For the past eight months we have been robbing Peter to pay Paul in the academic world. Bidding for available men in a field has proceeded with alacrity as one institution has taken men from another in order to satisfy its needs. The original supplies have been exhausted, but there is a new source to be tapped; the problem now appears possible of solution, at least in part, by the appropriate transfer and utilization of trained men from other fields. Geologists and economists can take over the teaching load in physics, chemistry or mathematics. Biologists and psychologists can take over other teaching duties in addition to those incident to their own important output, which must be maintained. It is possible that some teachers in history, classics, linguistics, anthropology and literature may also be fitted to teach in mathematics, particularly at elementary levels. The personnel of our schools and departments of education should be particularly applicable to such needs.

A teacher is a teacher, irrespective of the branch of learning. The methods and the students are the same—only the subject-matter is different. The university and college grade teacher can and must carry his personality and intellectual acumen into other fields of endeavor in addition to his own. This, while it may not be easy, is an immediate necessity. The standards and detail of subject-matter must be clearly presented to the substitute volunteers, and possibly refresher courses must be given by the specialists still remaining on the staff. This is one obvious source of man-power which can be utilized in the production of scientifically trained men.

A second source may be drawn upon from individuals who are in administration and have been removed from student problems for a long period of time. Many institutions are carrying a too large proportion of administrative officers, some of whom could be usefully reallocated at the universities' main job of production, teaching.

There is a third source as yet practically undeveloped and that is in the field of woman power in academic teaching. For many years women have been discouraged from attempting to enter academic fields. Now we need all of them that have been adequately trained and unfortunately that number is exceedingly limited, for when their placement has been made difficult for many years and their acceptance even by our leading female colleges has been rather tardy, all too few first-rate women scientists have been trained. To-day we could use ten times the numbers that are available if only the peace-time prejudices could be overcome.

From the above it is clear that there are many phases to the battle of scientific personnel production. One phase can not be overemphasized sufficiently, and rests with the personal conscience of many a teacher of science. It is easy to leave one's post and to accept new responsibilities, but are they always of greater utility than the accustomed routine or its possibility of rejuvenated potentiality? The importance of what you are now doing and how to intensify your effort must be evaluated by you individually. The home front is a pressing one which demands the best that we have if we are to keep our training program intact. We can not proceed on the simple substitute principle. A greater and more far-reaching view is demanded with a look toward a war future which is longer than any of us had ever anticipated. With this in mind let no one belittle his talents and opportunities on the home front of academic production. They are important, vital and of a degree of necessity which the country now demands. We will win the war—we must have trained thinking men to win and maintain the peace.

OBITUARY

ROSS AIKEN GORTNER
1885–1942

DEATH came Wednesday morning, September 30, to Ross Aiken Gortner, 57, chief of the Division of Biochemistry of the University of Minnesota, eminent scientist and scholar. Dr. Gortner had been able to carry on his work up to a few days before his passing, which resulted from a heart attack. He was first stricken with a heart ailment in the summer of 1938, and while the curtailment of his normal life of seemingly boundless energy was a sore trial to his spirit he made the adjustment with remarkable equanimity. Thus he was able to continue most of the scientific and social contacts to which he had been accustomed, and also carry the load of executive work of an expanding department as well as lecture to his classes, with few interruptions.

Dr. R. A. Gortner was born at O'Neill, Nebraska, on March 20, 1885. After graduation from Nebraska Wesleyan University in 1907 he earned his M.S. degree in 1908 from the University of Toronto, where he worked with the late Dr. W. Lash Miller, and his Ph.D. degree from Columbia University in 1909 under the direction of Dr. Marston T. Bogert. An honorary Sc.D. was conferred on him in 1932 by Lawrence College.

Dr. Gortner came to the University of Minnesota in 1914 as associate professor in the Division of Soils from the Station for Experimental Evolution at Cold Spring Harbor, N. Y. It was during the period at the Carnegie station that Dr. Gortner formed his close personal and scientific association with the late Dr. J. Arthur Harris, who probably exerted more influence on Dr. Gortner's scientific thinking than any other one person. This association culminated in Dr. Gortner being largely instrumental in bringing Dr. Harris to the University of Minnesota as head of the department of botany.