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ECONOMIC POLICY AND ECONOMIC DEVELOPMENT IN AUSTRALIA FROM 1945

A Study in Economic Administration

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High Commissioner for Australia in Canada

(Read November 13, 1953)

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I. INTRODUCTION

THE Australian economy is comparatively simple; a relatively small population (approximately 9 million), preponderance of primary production as the main source of exports and of national income, with wool still the major industry; general agreement that social services and the provision of social security should be a goal of political endeavour; the growth of secondary industry as a common objective of political parties; a relatively high and rising standard of living and an acute sense of politics; good political and financial relations with members of the British Commonwealth and the United States; an administrative structure broadly equal to the increasing tasks imposed upon it in the modern welfare state. In these circumstances one would have expected Australia to make the transition from war to peace easily and rapidly and to resume her normal economic development in the post-war world without any great economic disturbances; in a word, that economic stability would be easily attained for a country that had managed its war economy with

considerable skill, had a relatively low cost structure when the war ended and was producing the foodstuffs and raw materials for which the world would be in need. In the event, the Australian economy had a remarkable rate of development and population growth in the post-war period, but it showed certain weaknesses, and in particular displayed a considerable degree of instability in prices and costs, and in the balance of payments. We are apt to concentrate on the instability and to ignore the development, as though a high rate of development and stability in the economy were natural bedfellows. We know from history that this is not so, but the interesting problem to consider is why it was not possible to employ the developing arts of economic administration to impart greater stability to the Australian economy, despite its high rate of expansion. The study of economic techniques has advanced greatly in the last fifteen years, and Australian economists have not been without some influence in this important advance in one phase of social theory. It is the purpose of this paper to consider the problems of economic development in relation to administration in an economy like the Australian economy, and perhaps to offer some observations on the relations between economic theory and the art of public administration. If it be true that the economist has charted the way to avoid some of the egregious mistakes of the past, the question may well be asked whether the economist has not been working too much in a vacuum, whether in fact it is sufficient in the modern world to be only an economist, whether economists must not also be social philosophers with a flair for understanding the basic social and political forces moulding the social structure in which his theories may have to be applied.

2. CAPITAL DEVELOPMENT AND CAPITAL INFLOW

Before the war Australia had experienced the devastating influence of the depression, though

almost alone among the nations of the western world she evolved a somewhat ingenious plan for mitigating its effect by applying a theory of spreading the losses somewhat proportionately to ability to bear them.¹ But this was followed by a long period of malaise in investment and development throughout the whole of the western world, so that when the war came Australia, in common with other countries, was suffering from an acute shortage of capital equipment. The war involved concentrating on equipment of immediate use for war purposes, and when Australia came to be a supply centre for the Pacific there was a great stimulus to the development of secondary industries: steel and iron, engineering, ship-building, aircraft production, food processing, textiles. But the basic capital in transport, housing, hospitals, schools was still in short supply after the war; indeed the shortages that were already in evidence before the war became much more embarrassing when the war was over. This is the first point to emphasize in considering the course of events that followed. Secondly, the position was greatly exaggerated by the decision of the government in 1946 to embark on by far the most ambitious immigration policy in Australian history. It commenced with a programme of 70,000 migrants per annum and rose in two years, 1950-51 and 1951-52 to an average of approximately 170,000 per annum. In all some 725,000 immigrants were taken in between 1947 and 1952. It is hardly necessary to draw attention to the strain that this imposed upon basic capital requirements of a rapidly growing population.²

¹ The problems of the depression and the policy adopted are discussed in Copland, *Australia in the world crisis*, Cambridge Univ. Press, 1933, being the Marshall Memorial Lectures given at Cambridge University in 1933.

² The total work force rose from 3,238,000 at June 1947 to 3,600,000 at June 1952, an increase of 11 per cent in five years. On the one hand, there was a rapid increase in the numbers available for construction and development, but on the other hand their absorption into profitable production required a rapid increase in capital equipment. Moreover, the provision of living conditions on the current pattern of Australia imposed a heavy demand for capital.

With a higher post-war rate of natural increase the Australian population was growing at 3 per cent per annum. To meet this position it was necessary to step up the rate of investment. This was done, though it took some time to move from the war economy to a peace economy, and to get plans for both public and private investment adjusted to the post-war conditions. The following table shows the rapid increase in investment which is the third factor of importance to take note of in considering Australia's post-war economy. The rate disclosed by these figures is one of the highest in the free world. (table 1). (Figures in million pounds [£m].)

For a considerable period after the war the supply of capital was adequate. Bearing in mind the difficulty in meeting payments on a fixed-interest bearing debt during the depression, it was the fixed policy of Australia at the end of the war to avoid overseas borrowing on the old pattern. But there was a large inflow of private capital, partly for investment in developing secondary industries of Australia, and partly at one stage in the expectation that the Australian currency would be appreciated back to par with sterling. This capital inflow enabled the increasing investment demands to be met at relatively low rates of interest, and for a period the modern economist's dream of full employment and cheap money was realized. The total inflow of capital in the post-war period to the middle of 1953 was of the order of £670m, the most active years being 1948-49 and 1949-50. This inflow of private capital was an insecure foundation on which to base an ambitious development plan.³

³ For the years 1945-46 to 1951-52 the inflow of private capital from all sources reached the surprising figure of £780.8m, but there was a net out-flow of capital on account of public authorities of £110.6m in this period. The estimated net import of capital was thus £670.2m. This included items that would not be regarded as wholly available for investment in Australia, such as deferred payment to imports, unremitted profits and income, "hot money" coming in to profit by anticipated exchange appreciation. Nevertheless, the rate of inflow of capital for investment far exceeded the normal pre-war rate, or

TABLE 1

	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53
(a) Fixed Investment	269	355	470	666	876	1,124	1,094
(b) Gross Product	1,617	2,019	2,267	2,724	3,593	3,841	4,219
(a) as % of (b)	17	18	21	24	24	29	26

(Figures for 1952-53 approximate.)

Under Australian conditions development involves a high rate of public investment in the provision of power facilities, transport, housing, social capital of all kinds. The proportion of public investment to total investment approximates to 35 per cent, and unless public investment is active private investment will not be sufficient to sustain the required rate of development. In a word, private investment is no substitute for public investment in Australian conditions. It would be perhaps true to say that the basic condition of a successful expansionist movement in Australia is an active and healthy level of public investment. In the pre-war days at times when Australia was engaged in an active policy of expansion, such as the migration and development plans of the twenties, it was traditional to borrow in London and to a less extent in New York. This borrowing was undertaken by the State Governments whose responsibility it was to carry out the major part of the public investment. Not only was this practice abandoned after the depression, but Australia in 1932 embarked on a policy of debt repayment, and in the subsequent years repaid £A188m of overseas debt. The special conditions operating after the war, when there was a large inflow of private capital, masked the real problem, and it was too freely assumed that the country could sustain on its own resources the massive investment programme on which it had embarked.

External conditions had also changed. The United Kingdom was no longer able to supply capital in the form and quantity of pre-war days, and the only source of supply was the dollar area, and particularly the United States. But the United States had a poorly equipped money market for providing public capital at relatively low rates of interest, and Australia on her part was somewhat unwilling to become dependent on the United States for capital. There was the fear that the American economy was inherently unstable, and that it would be prejudicial to Australia's long term interests to become too closely tied to the United States. As it happened, the American economy proved to be much more stable than the Australian. In any case, the Australian economy would have been greatly affected by any change in the American climate, whether the policy of Australia had been to seek capital in the United States or not. In 1950, however, Australian policy

the rate that could be sustained for long after the war. It is in this sense that I refer to the immediate post-war inflow as "an insecure foundation."

TABLE 2

(Base: Years 1936-37 to 1938-39 = 100)

	Import Price Index	Export Price Index	Terms of Trade
1946-47	232	202	87
1948-49	285	333	117
1949-50	309	386	125
1950-51	375	663	177
1951-52	418	467	112

changed and borrowing at the rate of 50 million dollars (\$50m) per annum from the International Bank for Reconstruction and Development was commenced.

3. THE IMPACT OF FLUCTUATIONS IN PRICE LEVELS

Another factor that tended to mask the real facts of the position was the favourable movement in the terms of trade culminating in the post-Korean boom and the exceptionally high prices for wool in 1950-51. At the end of the war import prices were higher relatively to export prices, 203 compared with 151 on the base of 100 for the years 1936-37 to 1938-39. But this position was swiftly and, in the end, dramatically changed as table 2 shows.

Apart from the internal impact of rising export prices, this movement in the terms of trade gave to Australia a favorable balance of payments and enabled her to build up her international reserves to record levels at £843m at June 30, 1951. This again was an important factor in maintaining an easy money market, and in making the long term conditions under which alone it would be possible to sustain a high rate of investment and development.⁴

⁴ The movements in the International Reserves of Australia after the war were as follows:

June	£m
1946	215.4
1947	198.7
1948	273.5
1949	451.7
1950	650.1
1951	843.0
1952	361.9
1953	548.1

Before the war the desired level was only about £80m, but with the change in prices and the altered condition of the London money market, the basic figure would be much higher, perhaps four times the pre-war figure. The sudden drop of nearly £500m in 1951-52 brought reserves close to the desired level and created a critical situation which is discussed later in this paper.

TABLE 3
RETAIL PRICES
(Base: Average 3 years ended June 1939 = 1,000)

1946-47	1,309
1947-48	1,392
1948-49	1,528
1949-50	1,669
1950-51 (June Quarter)	2,067
1951-52 (June Quarter)	2,488
1952-53 (June Quarter)	2,590

The combined influence of rising export and import prices, and the pressure of demand upon resources brought about by the rapid growth of population, inevitably exerted a strong inflationary pressure. During the war this pressure had been held in check by an elaborate system of controls, and by a general agreement that all else should be subordinated to the mobilization of resources for war. An effective system of price stabilization had been imposed early in 1943 and prices were held during the rest of the war at a level less than 30 per cent above the average of the three pre-war years, and approximately 22.5 per cent above the level at the outbreak of war.⁵

This achievement was in striking contrast to the experience after the war when some controls such as wage control, material supplies, rationing were modified and greatly relaxed, while price control was removed on many non-essential goods. The position was held fairly successfully till 1946-47 when the retail price level, or cost of living as it is commonly designated in Australia, was still only 31 per cent above the average of the three pre-war years. Thereafter the movement upwards gathered strength as table 3 shows.

It will be observed that the greatest rate of increase was from 1949-50 to 1951-52 when the rise was approximately 50 per cent. There were many forces pushing up the price level: general and forcing pressure of demand for all resources,

⁵ An account of Australian war economic policy is given in *The Economic Record*, the half-yearly journal of the Economic Society of Australia and New Zealand. See the issues of 1940 to 1945.

the impact of higher import and export prices, rising wage rates and labour costs. All these were operating continuously over the whole period till the second half of 1952. But the most active force was the sudden and tremendous rise in export prices in 1950-51, especially in the prices of wool and metals. The average price of wool for that season was an all time record at 12/-per lb., yielding a total income from wool of £636m. In the previous year the price had been considered high at 5/-per lb. and the total income very satisfactory at £270m. There can be little doubt that this boom in wool was by far the most important single inflationary force in the post-war economy.

In the late twenties and early thirties the Australian economists had worked out very fully the impact of the multiplier on the Australian economy, in so far as the multiplier was a function of overseas income.⁶

Variations in this income whether from changes in prices of exports, changes in seasonal conditions or changes in the inflow of capital were by far the most dynamic influences in the economy. It was to prove so again. The repercussions from the high wool incomes were swift and devastating on the general level of incomes and values, and of course the general inflationary atmosphere of

⁶ See in particular L. F. Giblin, *Australia 1930*, The Melbourne Univ. Press, 1930, for a statement of the operation of the multiplier in the Australian economy. Though not as comprehensive a statement of the principle of the multiplier as was later to be developed at Cambridge University by R. F. Kahu, it was the first statement of the concept and was embodied in the inaugural lecture delivered by Giblin as the first Ritchie Professor of Economics in the University of Melbourne. The basis of the concept of the multiplier, and of the impact of repercussions from changing import and export prices on the Australian economy, is to be found in *The Australian tariff: an economic enquiry*, Melbourne Univ. Press, 1929, by a committee consisting of J. B. Brigden, D. B. Copland, E. C. Dyason, L. F. Giblin and C. H. Wickens. In deference to my late colleagues on the enquiry, I feel bound to record the view that this book remains, despite the catastrophic changes of more than two decades, the best analysis of the forces controlling the Australian economy.

TABLE 4
NATIONAL INCOME AND GROSS PRODUCT
(Figures in £m.)

	1938-39	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53
National Income	780	1,388	1,767	1,958	2,302	3,126	3,250	3,579
Gross National Product	922	1,642	2,036	2,291	2,724	3,633	3,853	4,219

the moment provided the ideal background for the impact to be passed on quickly and surely. The figures for national income and gross national product are eloquent on the point. I give them for the whole of the post-war period together with the 1938-39 figures for comparison (table 4).

The rise from 1949-50 to 1950-51 is the striking feature of these figures, being no less than 36 per cent. The very high level of export incomes was short-lived and there was a drop of 45 per cent in farm income between 1950-51 and 1951-52. It was this that was responsible for the small increase in national income in 1951-52 over the previous year, despite the fact that under the impact of rising prices and wage increases salaries and wages had increased by 26 per cent.

4. MOVEMENTS IN WAGES

A significant feature of the post-war economy was the continuous and at times rapid rise in the level of wages. Taking the adult male basic wage as declared by the Arbitration Court on the base of the three pre-war years as 1,000 the figure was still only 1,343 for 1945-46, and the real wage was only 5 per cent above the pre-war level. This is the minimum wage, not the average earnings, which had risen by more because of overtime and the general tendency for labour to have a scarcity value. But the movement had been fairly well checked during the war. After the war the peg on wages had been removed, the Court gave favourable judgments on applications from the unions and the practice of an automatic quarterly adjustment to changes in the cost of living was continued, and, if anything, made more general in application. The nominal value of the basic wage rose rapidly, the index reaching 1,565 in 1947-48, 1,913 in 1949-50, 2,806 in 1951-52, and 3,102 in the December quarter of 1952. The most important increase granted by the Court was that of £1 per week on the male basic wage in 1951 and an adjustment in the female basic wage to 72 per cent of the male wage from a previous level of only 54 per cent. The effect of these changes was to raise the income of wage and salary earners from £619m in 1946-47 to £950m in 1949-50, £1,172m in 1950-51, £1,460m in 1951-52, and £1,577m in 1952-53. Meanwhile, the volume of employment had risen from 2,202,000 in 1946-47 to 2,624,000 in 1951-52.⁷

⁷ These figures are the average monthly totals for employment of other than rural and defence employees and are different from the total work force mentioned in note

The increase in the volume of employment had been 20 per cent while the increase in the value of total income to salary and wage-earners had been 135 per cent. In the same period the retail price level rose by almost 80 per cent. On a crude estimate these figures would imply that, without any change in prices or productivity, the income to wage and salary earners should have risen by 20 per cent. Applying the rise in prices at 80 per cent, this would give a rise of 116 per cent as a result of the combined influence of prices and larger numbers. In fact, the increase was 135 per cent, and this would signify an increase of just under 9 per cent in productivity. This calculation is admittedly very rough, but allowing for the reduction in standard hours from 44 to 40 per week soon after the war, and the general slackness prevailing in an inflationary movement, it may well be a fairly close approximation to the movement in productivity in this period. This position was to be affected by the events of 1951-52, as indeed was the economic situation in so many other respects. Productivity rose for the year 1952-53, as will be shown later.

5. THE ADMINISTRATIVE STRUCTURE

We may lead into a consideration of the events of the crucial year, 1951-52, by some consideration of the general economic policy that governments sought to pursue after the war. Australia is a federal structure with larger powers in the hands of the States than has been the normal tendency in the American system, and certainly than the Canadian pattern. But all federal structures tend to be centripetal in their working, especially under the impact of war, and Australia was no exception to this rule. The federal government came out of the war with a much tighter hold on public finance and banking policy than before the war. This was due on the one hand to the institution of the uniform taxation system in 1941, whereby the Commonwealth collects the income tax as the single taxing authority and makes grants to the States; and on the other hand to the alteration in the authority of the Commonwealth Treasury and the Commonwealth Bank, acting in its capacity as a central bank, over the whole

2 above, which includes farmers and all other proprietors. The figures given here as a measure of employment may exaggerate the increase in the number of salary and wage-earners and therefore give too low a figure for the crude measure of productivity. However, the difference would be slight.

banking system. The State governments, and the public authorities established by them, had a works programme two to three times the value of the works programme of the Commonwealth. The States were in effect even more responsible for public investment than the Commonwealth, but the Commonwealth was much more the guardian of financial stability than the States. The meeting point was at the periodical gatherings of the Premiers' Conferences where these problems were discussed, not always in the most amicable spirit, prior to the meeting of the Australian Loan Council. This latter is a statutory body, unique in the modern history of federations. It was formally established in 1923 as a voluntary body but given statutory powers in 1928 after an important amendment of the Commonwealth Constitution under which the Loan Council became the sole authority that could approve borrowing programmes, other than for the purposes of defence. This body is composed of the Treasurers of the Commonwealth and the six States, with the Commonwealth exercising two votes and as chairman also a casting vote. It was intended to provide a check on the individual State approach to the overseas loan markets in the days when foreign borrowing was a marked feature of Australian economic policy, and also to exercise some control over the rate of borrowing. It is possible that it was too rigid in its attitude in the thirties when a higher rate of public investment would have been more in the interests of the nation as a whole. Since the war the atmosphere has changed and the Loan Council has constantly been faced by demands for total borrowings in excess of the resources of the money market, especially in the past three years when the rate of public investment had reached such a high level, and later when the money market was less buoyant. The Council has been unable in the past two years to meet the demands of the States in full with the result that some works have had to be suspended in a rather uneconomic manner. To assist in preparing a balanced programme, as well as to ensure that the level of public investment could be used as a means of ensuring a high level of employment, a National Works Council was set up at the end of the war composed of representatives of the States and the Commonwealth. This Council prepared a large programme of national works awaiting construction, but it has not at any time performed the important service of preparing in advance a programme based upon relative urgency

of works, the state of the loan market and the volume of employment. In contrast to the Loan Council, the Works Council is an advisory body only, but even in this role it had not fulfilled the function that its sponsors planned for it. It was in fact part of the machinery designed during the war to ensure a balanced programme of development and a high level of employment as objectives of economic policy in the post-war period.

6. THE FRAMEWORK OF SOCIAL POLICY

The Commonwealth Government in 1946 issued an important White Paper on Employment setting forth as a principle objective of policy the maintenance of a high and stable level of employment. In popular parlance, and in the minds of some of the more enthusiastic theorists, this became known as a policy of "full employment," to be defined as "more jobs than there are people to fill the jobs."⁵

The White Paper purported to work out the technical problems to be solved in maintaining high employment in a dependent economy like that of Australia, but the introduction of an ambitious policy of immigration does not seem to have been considered in relation to the employment objective. This came a little later as a result of a more realistic attitude of the government and the trade union leaders to Australia's position in the post-war world; it did not enter into the calculations of those who were planning a full employment economy after the war. Nor does it seem to have been a matter for careful consideration how the pursuit of the welfare state, with its emphasis on security and a high level of consumer spending, would affect the desideratum of a high level of employment. Yet, the welfare state has become a common objective of all governments, State or Federal, and of all political colours. It is perhaps the one political objective held in common by all parties, and the post-war period has witnessed a great increase in the provision for social services and pensions and in the safeguards the welfare state provides for social security. Finally, as the post-war policy took shape there emerged some major developmental projects both public and private that were to absorb resources on a large scale. These four strands in post-war policy, full em-

⁵ I discussed the problems of employment in the Godkin Lectures at Harvard University in 1945. *The road to high employment*, Harvard Univ. Press, 1945. The more ambitious expression of the thesis current mainly in official circles in Australia is given in the Joseph Fisher Lecture delivered at the University of Adelaide by Dr. H. C. Coombs in 1944.

ployment, a high rate of immigration, the pursuit of the welfare state and the promotion of major developmental projects can be brought into a consistent whole, and adjusted to the circumstances of the Australian economy. But it would be claiming rather too much to contend that they were consciously planned as integral parts of grand economic strategy, or that their rate of execution was considered in relation to the controlling influences in the economy. It is not easy to do this in a unitary state; still more difficult in a federal structure where governments may be jealous of their prerogatives and unduly concerned with their own immediate interests. This was the situation in Australia, and some of the difficulties that followed were due to differences of approach among the several governments. But perhaps the greatest single weakness was the failure on the part of those responsible for the major elements of policy to work out their impact on the economy as a whole. In particular, the doctrine of full employment was played up too much and the difficulties that might be encountered played down too much. That full employment could meet obstacles arising from balance of payments difficulties was recognized, though insufficient attention was paid to them. The advocates of full employment were content to assert that the use of restrictions on imports would be an ever-present remedy. It was in fact an integral element of policy that some controls would be in the best interests of economic stability, and import restriction was a ready favourite. It was a weapon that fortunately was not available in the depression; it is too near at hand to most governments now to compel them to be as careful about their planning as they had to be in the days of greater freedom of trade. Another difficulty facing full employment was the likely pressure for higher wages with rising labour cost, due in part to the level of money wages, and in part to the lower level of efficiency. This was to be met by price control and perhaps, as Lord Beveridge put it, by the exercise of restraint by trade union leaders. But when considered in relation to the development of the welfare state and the high level of investment, there could be little escape from the fact that full employment in its extreme form would be a constant inflationary force, that this in turn would raise the level of spending and of imports and thus cause difficulties in the balance of payments. Further, there was the ever-present danger that costs would rise until they got out of focus with world costs,

thus hampering the export trades and giving rise to further balance of payments difficulties. The remedy for this no doubt would be further import restrictions; all roads lead to that when a country embarks on an economic policy that increases costs and spending power beyond the level set by real productivity.

7. MEMBERSHIP OF THE STERLING AREA

An integral element of Australian economic policy after the war was the decision to adhere to the sterling area. This naturally involved imposing restrictions upon purchases from the dollar area and joining with the United Kingdom and other members of the sterling area in pooling dollar reserves. The advantage to Australia from this course of action was the certainty of being able to meet agreed dollar commitments, the membership of a substantial area in which trade and capital movements would be relatively free, the continuance of intimate trade relations with the United Kingdom, giving the benefits of long term purchase contracts for certain Australian exports, and relative freedom to pursue social policies that might involve movement in costs at variance with costs in the non-sterling world. There was also the feeling in certain official circles that the American economy would be unstable under the uncertain conditions of the post-war world, and that it was the path of prudence to insulate the Australian economy from undue risks of instability.

This was one of the reasons why Australia avoided any loan commitments in the dollar area but, as already shown, there was a fortuitous import of capital mainly from the United Kingdom so that for the immediate post-war period there was no scarcity of capital for development.⁹

This is not the place to trace the history of the sterling area or to deal with all the issues involved in the relationship between sterling and the dollar, and the several crises sterling encountered in the post-war period. During the whole of the post-war period, up to June 30, 1953, Australia had a deficit on current account of \$693m. In only one year, 1950-51, when wool had its record price, did Australia have a dollar surplus on current account, the surplus being \$71m. These are the figures for the Australian deficit in the dollar pool

⁹ The issues involved in this decision of Australia to adhere to the sterling area are discussed at some length in my pamphlet, *Problems of the sterling area with special reference to Australia*, issued by the International Finance Section of Princeton University, 1953.

of the sterling area. It is, however, impossible to segregate all the transactions and to know whether the deficit recorded should be regarded as the real dollar deficit of Australia. Thus, meat supplied to the United Kingdom from Australia at lower prices than might have been earned in the dollar area would ease the dollar problem for the United Kingdom. Wool shipped to England or Europe for sterling might earn dollars on the garments manufactured from it. It was, however, the deliberate policy of Australia to contribute as much as possible to easing the dollar problem for the sterling area. To this end increasingly severe restrictions were imposed upon imports of dollar goods, and Australia readily entered into agreements with the United Kingdom under which certain Australian exports were sold as bulk supplies to the British Government.¹⁰

Whether this policy was in the long term interests of Australia or not remains a disputed question, but it is fairly clear that the short term problem in the immediate post-war world was rendered easier of accomplishment by Australia's adherence to the sterling area. From the long term point of view, however, certain considerations raise doubts whether the facilities of the sterling area would offer sufficient scope for expanding markets on the one hand, and the supply of capital on the other. In the first place, it is of interest to record that the percentage of Australian exports going to the United Kingdom market fell from approximately 50 per cent pre-war, to under 40 per cent in the latter part of the post-war period. On the other hand, the proportion of British exports to the sterling area rose from 48 per cent pre-war to 55 per cent by 1952. Generally speaking, the overseas members of the

¹⁰ Insufficient attention has been given to the effect of these long term purchase agreements upon the traditional pattern of Australia-United Kingdom as determined by Imperial Preference, and especially by the terms of the Ottawa Agreements of 1932. These Agreements were supplanted by the guaranteed bulk purchase arrangements leaving only sugar, wine, and dried fruits as Australian products to retain the benefits of preference in the markets of the United Kingdom. For imports into Australia the full benefits of the Ottawa Agreements were continued. In a survey of this problem on December 11, 1951 I summarized the position as follows: "Thus our present trading arrangements with the United Kingdom result in the sale of our export foodstuffs at prices highly favourable to the United Kingdom, while the preferential system is of little value to Australia, but of great and growing value to the United Kingdom." This was one of the consequences of the "shelter" we gladly accepted from membership of the sterling area.

sterling area have found that a smaller percentage of their exports are now absorbed in the United Kingdom than was the case before the war. Presumably this implies that the rate of expansion is greater in markets other than the United Kingdom. This is what would be expected in the circumstances, and it is very important for an economy like that of Australia in which raw materials and food occupy so prominent a position in the export trade. This is the first ground on which some doubts may be entertained concerning the concentration of Australia upon the sterling area as a major ingredient of post-war economic policy.

In the second place, the question of capital for an expanding economy is of prime importance. We have already seen that in the early post-war period there were unusually large imports of capital on private account, mainly from the United Kingdom and that this gave the Australian money market exceptional buoyancy. Thus, for a period, the provision of capital for development did not impose any severe strain. But these conditions have undergone considerable change in the past two years. First, as will be shown later, the Australian balance of payments was thrown severely out of gear in 1951-52 and this in itself imposed considerable stringency in the local money market. Secondly, the flow of capital has been reversed for the time being and when a net inflow is resumed, it is almost certain to be much less than the big post-war movement. Consequently, it is unlikely that the United Kingdom or the sterling area will be able to supply sufficient capital to maintain the rate of development required in Australia. This has in part already been recognized by the change in policy adopted in 1951 when Australia commenced borrowing from the International Bank for Reconstruction and Development at the rate of \$50m per annum. In the last main expansionist movement in the twenties the Australian rate of borrowing was \$150m per annum overseas. There were many who contended that this rate was excessive but if one allows even for cutting it down to \$100m, the present rate of borrowing, of \$50m, is far from adequate.¹¹ The value of the dollar has depreciated

¹¹ There is ample evidence in the writings of the Australian economists in their analysis of the Australian economy in the twenties that they were all concerned about the high rate of borrowing. See especially G. L. Wood, *Borrowing and business in Australia*, Melbourne Univ. Press, 1929; frequent articles in *The Economic Record*, which commenced publication in 1925; E. O. G.

and the rate of development is much greater so that borrowing at the rate of \$200m per annum would not be excessive, provided the high level of immigration and development were maintained. It is clear that the sterling area itself cannot supply capital in this quantity and that it is only available from the dollar area.

The third ground for doubting the efficacy of the sterling area as a long term solution for Australia lies in the increasingly restrictive practices that have been developed by members of the sterling area over recent years. These restrictions apply not only to trade and financial transactions between the sterling and the non-sterling worlds, but there has been a growing tendency to apply them within the sterling area. Consequently, neither trade nor capital transfers are free from restrictions, as was hoped would be the case within the sterling area. The tendency to apply quantitative restrictions on imports to meet the difficulties in the balance of payments is a phenomenon of the post-war world. It was, of course, a device of the autarchic school before the war but it is now far more prevalent in the free world than one would have expected twenty years ago. Because of the inherent instability of the Australian balance of payments, restrictions on both trade and capital transfers have become a marked feature of Australian economic policy.

8. THE COSTS OF RESTRICTION

It is not necessary to dwell at any length upon the economic repercussions of such a policy pursued over a long period. In the pre-war days, the Australian economists, in their analysis of the economy, divided the national income into three parts, namely, income derived from export production, income derived from protected produc-

tion, and income derived from sheltered production.¹²

Sheltered production needs a word of explanation. It was the residual or tertiary production of goods and services which in all countries has a natural shelter from direct overseas competition. In the pre-war analysis it was shown that the costs of protected production fell ultimately upon export production. A quite interesting analysis was made of the process by which the costs of protected production were passed through sheltered production, raising prices and costs in that field and finally resting upon protected production where costs were increased without any certainty that world prices would admit of any increase in the prices of exports. This is, of course, a traditional argument against excessive devotion to protective tariffs. It is possible to devise a measure of the costs of protected production when the protection is afforded by the normal tariff. When, however, the protection is afforded by embargoes or direct restrictions on imports, the field of competition is very greatly narrowed, the costs are higher and are much more difficult to measure. Moreover, a continuance of restrictive practices over a considerable period of time creates strong vested interests in protected production, the more so the further removed from world market conditions are the prices of this production. There is considerable evidence to show that this process has gone rather too far for the good health of the economy in Australia. Certain measures of direction of resources have been pursued since the war, particularly through capital issues and through the direction of immigrant labour into what would be regarded as the more essential industries, but these measures were by no means effective against the opportunity offered to establish or expand industries behind an increasing measure of import restriction.¹³

Shann, *Economic history of Australia*, Oxford Univ. Press; and the analysis in *The Australian tariff: an economic enquiry*, already referred to. But it was not questioned that a migration and development programme required some foreign capital. In the period 1947 to date the rate of migration and development is much greater and the need for capital consequently greater. In the changed climate of Australian opinion and the altered conditions of foreign lending on public account since the war no considered plan has been developed for the supply of the necessary foreign capital to sustain the desired level of public investment, if the present rate of migration and development is to be sustained. This is one of the vulnerable points in Australian economic policy since the war.

¹² The best and most original exposition of this treatment of the national income is to be found in *The Australian tariff: an economic enquiry*, referred to above. See also L. F. Giblin's Joseph Fisher Lecture in the University of Adelaide, 1930, on the Australian tariff. The analysis has been rather neglected since 1939, but in the more rigorous times ahead its virtue will be rediscovered by both the academic economists and the official administrators.

¹³ The case for maintaining import restrictions is highly plausible. It is argued on two grounds. The first is that the vagaries of Australian export income and consequently of the Australian balance of payments necessitates some method of directly controlling imports. This view has some support in current economic discussions in

With rising export prices and restrictions on imports from non-sterling countries, it was easy for costs and prices in Australia to move greatly in advance of costs overseas, even including costs in the United Kingdom at a time when deliveries were delayed and export prices of goods from the United Kingdom were as high as the market would bear in order to earn overseas income. I have made a comparison of the retail price index and average weekly earnings in manufacturing for Australia, the United Kingdom, Canada, and the United States between 1948 and 1952. The retail price index may be regarded as giving an indication of movements in costs while average weekly earnings would represent changes in money incomes. I am aware of the perils of such comparisons and in the Australian case, because of the strong impact of export prices, the rise in retail prices might well over-state the increase in costs, while the earnings in manufacturing might well understate the rise in incomes as a whole. However, the figures include the period from July 1951 to December 1952 when export prices and export income had fallen from their peak in 1950-51, so that the distortion is not as great as it might appear at first sight to be. I have added a third column showing the ratio of the rise in average earnings over the rise in retail prices which may be taken as a measure of the increase in real income and a rough measure of the improvement in productivity. The figures are given in table 5.

Australia and is in part a result of the more pronounced tendency towards economic control. It is by no means an exotic product in the United States where there is far less need to worry about variations in the balance of payments or devotion to economic controls. This leads to the second ground on which maintenance of restriction of imports is advocated. This is the need to shelter local producers from the competition of imports. But it is a natural corollary of import restrictions that such local producers will exist, especially if the restrictions have been operative for a period. These producers will, for the most part, have relatively high costs and will be embarrassed if exposed to normal competition from imports. Hence import restrictions once imposed are exceedingly difficult to remove, and there is little doubt that they raise the local cost structure. It may be argued that the Government can always take measures to ensure that industries will not be established at uneconomic levels behind the restrictions. But where has that happened? Certainly not in Australia, nor in the rural economy of the United States. Perhaps in the U.S.S.R.! Better to incur the inconveniences of instability in the balance of payments than to have resort to a weapon that is even less capable of control and perhaps more corrosive of economic efficiency than any other measure of control in the economic armoury of a supposedly free world.

TABLE 5
PERCENTAGE INCREASE IN PRICES AND EARNINGS
1948 TO 1952

	Retail Prices	Weekly Earnings in Manufacturing	Real Earnings
Australia	70	79	5.3
United Kingdom	26	29	2.4
Canada	21	39	14.8
United States	10	26	14.5

It is clear that, whatever may be the defects of the statistical comparison, the Australian price and cost structure moved far in excess of that of the outside world without any considerable advance in real earnings or in productivity.

Perhaps of even more significance is the fact that the imposition of further restrictions, as happened over the balance of payment crisis in March 1952 tends to consolidate the high cost structure. Thus, when the heavy restrictions were imposed in March 1952 on sterling and non-sterling goods alike, the tendency was to make a stock of surplus goods on hand liquid, and to enable them to be disposed of over a period at the current high prices. I shall return to this point later when discussing the anti-inflationary policies pursued between 1949 and 1953. Here it is only necessary to say that, whatever anti-inflationary measures may be devised, the imposition of widespread import restrictions is one of the most powerful means of destroying their efficacy. So, on this ground, the pursuit of policies involving adherence to the sterling area may well be regarded as having left Australia with a much higher cost structure than would have been the case had the economy been more exposed to world competition.

Finally, there is the question of social policy. Owing first of all to the high level of export prices and the heavy inflow of capital, plus the restrictions on dollar goods and financial transactions, the Australian economy had a relatively high degree of insulation from world conditions. In this favoured atmosphere it was possible to proceed with an advanced social policy involving increasing payments of social services, more extensive measures of social security, shorter hours of labour, and rising money wages. Whether these policies could have been pursued as fully as they were had the economy been more open to the impact of world conditions will remain a matter for speculation. It can, however, be said that with a less buoyant

export price level, a lower import of capital and more direct competition from imports, the pursuit of this progressive social policy would have been undertaken at a lower price level and with lower money incomes. In these circumstances, it may be doubted whether the policy could have gone as far and as rapidly as it did. An atmosphere of inflation masks much of the disturbance that would normally be caused by a policy involving a substantial movement towards greater income equality. Moreover, it obscures the importance of capital formation for the time being.

For all these reasons, it is legitimate to cast doubts upon adherence to the sterling area as the predominant feature of long term external economic policy.

9. THE MILK BAR ECONOMY

In the early years of the post-war period the Australian economy was under great strain in adjusting production to the demand for essential commodities. It was not so much that production as a whole was lagging, but rather that the distribution of resources was not altogether appropriate to the special needs of the post-war period when rapid increases in demand for essential commodities were taking place, and there was, as already stated, a heavy backlog of investment to make good. Output in the basic industries up to, say, 1947-48 remained relatively stationary compared with output in the non-essential industries. Thus, there was a lack of balance in the productive effort between what might be regarded as basic and non-basic industries. In a brief study of this problem early in 1949 I divided industries into four groups as follows:

First, there are the industries providing the staple foodstuffs and fibres for industry; secondly, the industries on which depend the maintenance and expansion of the community's capital stock, including housing; thirdly, the industries essential to the development of power and the provision of power itself; and fourthly, the industries essential to the expansion of the volume of export production.

As regards the first group, the output had remained stationary or had in some cases even declined as compared with the pre-war position. Much the same story was true of the second group, which showed either a decrease in output between 1938-39 and 1947-48 or a very slight increase. The only products in this group which showed an increase in output of more than 25 per cent were

cement building sheets, fibrous plaster sheets, sawn native timber, and sulphate of ammonia. For the rest, the increases, where they occurred, were very slight. Thus the production of pig iron was up by only 12 per cent, of ingot steel by only 9 per cent and of roofing tiles by only 4 per cent. The number of houses completed ranged around 11,000 per quarter in 1947-48, and this was approximately the pre-war level. One would not have expected, in so short a time, a rapid increase in the third group, namely, industries essential to the development of power, though a substantial rise in the output of coal might have been anticipated. In fact, coal output was 21 per cent higher in 1947-48 than in 1938-39, and the production of electric power very little above the pre-war level. These industries, however, have a fairly long gestation period, and in the post-war years plans were being developed for expansion later. A similar situation was unfortunately true of the export industries where the continuing rise in prices masked the failure to expand the volume of exports. Up to 1947-48 the actual volume of production in dairy products and meat and in metals was lower than pre-war, and the volume in wool and wheat slightly above. Despite expansion of productive capacity during the war in certain secondary industries such as steel, engineering products, textiles and food processing, there was no marked increase in the volume of these products exported after the war.¹⁴

This is a brief summary of the situation up to 1947-48. It indicates that essential production had shown a disappointing response in the immediate post-war conditions. This was due in some cases to preoccupation with long term plans for expansion of output such as was happening with steel and with hydro-electric power. If we consider the industries in which the volume of employment had increased by more than 50 per cent, we can get a broad picture of what was happening to resources. Manufacturing showed an increase of 53 per cent, road transport 73 per cent, communications 89 per cent, public authority activity 161 per cent, health services 64 per cent. As regards commodities where the output was up by more than 50 per cent, we have a sample somewhat as follows: oatmeal 92 per cent, prepared breakfast foods 58 per cent, processed milk products 198 per cent, canned meats 244 per cent, ice

¹⁴ See my article, Balance of production in the Australian post-war economy, *The Economic Record*, December 1949.

cream 197 per cent, soap 128 per cent, cricket bats 132 per cent, domestic refrigerators 282 per cent. Few of these can be regarded as basic products. Even in the case of road transport the difficulty lay in the ineffectiveness of the railways, and road transport turned out, in the end, to be a very costly diversion of resources.

The general picture one gets is that the volume of employment in the more essential industries was expanding very slowly, if at all, while the volume of employment in the less essential industries was expanding at a very rapid rate. It can hardly be claimed that the direction of resources in the immediate post-war period was calculated to serve the long term needs of a rapidly developing economy. Some of the trouble no doubt was due to the administration of price control under which the products of the non-essential industries were removed from the scope of control while the more essential products were kept under control. It would be possible for the non-essential industries to earn higher profits and at the same time to compete for resources and offer higher wages. There was also the impact of shortages of imported materials from abroad, and of the restrictions on dollar imports, to which reference has been made above.

Whatever be the basic cause of this mal-distribution of resources, the facts were such as to render not altogether inappropriate my application of the phrase "the milk bar economy" to the Australian economy in 1949 in the article referred to in note 14. At that time immigration plans had reached their fruition, and the number of migrants was at a record annual level of 190,000. Investment was also being stepped up, the actual proportion of fixed investment to gross product having reached 21 per cent in 1948-49. The economy was thus under greater strain because of a mal-distribution of resources, and this strain was to become all the more evident with the sudden spurt in export prices that occurred after the outbreak of the Korean war in the middle of 1950. "The milk bar economy" was a rather inadequate foundation upon which to build a rapidly expanding economy; its weaknesses were to become even more pronounced when export prices rose dramatically and there was no adequate plan to dampen down the inflationary impact of a high export income.

It may be an idle speculation but the Australian economy in the immediate post-war years seemed to fall between the two extreme positions of aban-

donment of control on the one hand and the maintenance of rigid wartime controls on the other. It is possible to organize the distribution of resources under a system of rigid control; it is equally possible to contemplate resources being distributed in response to needs under the impact of an open price system. There will continue to be dispute as to which of these two extremes produces the most desired result. The matter is not to be decided purely on economic grounds. Social and political influences are perhaps even more important. Those economies in the western world, such as the American and Canadian economies and, to a less extent, the German economy, where the prime political sentiment was in favour of getting rid of controls, had a distribution of resources more favourable to the needs of the post-war world than the economies in which a hybrid system of control was maintained. It may even be contended that in the light of recent events, the distribution was also more favourable in the long run in these "free enterprise economies" than it was in the more tightly controlled Communist regimes with their undue emphasis upon investment at the expense of the standard of living. Be that as it may, the half-hearted sentiment in favour of control in the Australian economy and the conflict of jurisdiction between Commonwealth and State, undoubtedly contributed to the mal-distribution of resources, to which reference has already been made. The position was to be corrected in the next three years, partly by conscious effort through the direction of immigrant labour into the basic industries, partly by long term investment plans coming to fruition, and partly by the measures that had to be taken in the end to cope with the great inflation that followed the rise in export prices in the middle of 1950.¹⁵

¹⁵ Migrants under contract, the Europeans who were selected and assisted in meeting their transport costs, were distributed as follows among industries in 1951:

Primary Production	9.5%
Investment Industries	53.5%
Consumer Goods	16.2%
Public Services	13.5%
Private Services	7.3%

Of perhaps more significance are the following statistics showing the proportion of migrant labour to total labour in certain industries in 1951.

Iron and Steel	25%
Cement	30%
Timber Getting and Milling	8%
Bricks and Tiles	15%

Increased output in these vital industries after 1949 was thus in part due to the judicious direction of labour to

10. THE GREAT INFLATION

When wool began to reach record levels in the selling season of 1950-51 and metal prices also rose under the impact of the Korean war demand, by far the strongest inflationary force of the post-war period began to operate in a situation which was already one of considerable inflationary strain. The added income direct from the higher prices for exports was some £400m. The indirect effect of this new income would be at least one and a half times as great as the direct effect if the latter were allowed to have its full effect upon the economy. This is, of course, the familiar operation of the multiplier in the Australian economy where variations in export income are the most important single influence affecting the general level of incomes, of costs and prices.¹⁰

As it happened, national income rose between 1949-50 and 1951-52 by £824m, or approximately

essential industries. Thus while the high rate of immigration imposed a severe strain upon the economy as a whole, it made a significant contribution at certain vital points to restoring a balanced use of resources.

The response of output in primary production in the immediate post-war years was a disturbing feature of the position. Thus taking the average for 1935-36 to 1938-39 as base at 100, the output on the average of the years 1946-47 to 1950-51 for leading commodities was as follows: wool, 92; wheat, 102; whole milk, 90; beef and veal, 92; mutton and lamb, 86; sugar, 88. This unsatisfactory position was in part due to severe drought in the early part of the post-war period causing great losses in sheep and cattle, in part to the greater profitability of wool over animal husbandry and agriculture, in part to acute shortages of labour. The sheep population fell by over 25,000,000, more than 20 per cent but was rapidly recovering at the end of the period. Such are the hazards of rural economy in Australia! These considerations also show that the development of what I have called "the milk bar economy" was a many-sided thing.

¹⁰ In pre-war days the multiplier as based upon export income was considered to be 3, so that an addition of £100m to export income would add £300m in all to national income when the repercussions set in motion by the higher export income had spent themselves. The same results would follow if protected production were to become more efficient in its competition with imports. In post-war conditions the ratio of "exports and other receipts for goods and services" to gross product was higher; 22 per cent for 1952-53, 24 per cent for 1949-50 compared with 17 per cent for 1938-39. In the boom year the ratio was 33 per cent, but that was a special case. On these figures it might be argued that I should use an even higher multiplier than for pre-war, instead of 2.5 as suggested in the text. Public works and protected production and the operation of fiscal policy and a more equal distribution of income were more important in post-war conditions and on that account I have judged the multiplier to be smaller.

36 per cent. This rapid repercussion of the higher level of export income was due in part to the background of inflation in which the rise of export prices was operating. All price levels registered marked increases immediately. The retail price level moved up from 167 for the average of the year 1949-50 to 207 for the June quarter of 1951 and 249 for the June quarter of 1952, despite the fact that the year 1951-52 witnessed a fall of 45 per cent in the price of wool and approximately the same percentage drop in income from wool. Thus, within two years the retail price level had moved up by just under 50 per cent. This was by far the most rapid increase in the price level Australia had experienced since the gold rushes of the '50's of the last century.¹⁷

Meanwhile, the basic wage for adult males had moved from 191 on the average for the year 1949-50 to 305 for the September quarter of 1952, an increase of 60 per cent. This was due in part to the automatic adjustment of the wage to the cost of living, and in part to a special increase in the basic wage awarded by the Court at the end of 1951.

There was much discussion and controversy as to what was the prime generating force in this rapid increase in prices. Undoubtedly there was a pressure of demand on all resources, brought about by the expansion of investment and the rapid increase in immigration. The years 1949-50 and 1950-51 registered the highest intake of migrants after the war, being, respectively, 184,900 and 153,300, but there is no reason to suppose that the impact of an expanding economy and immigration would have caused so substantial a rise in wages and costs in the period in question. Undoubtedly, they would have continued to exercise an inflationary influence, but it is significant that the rapid increase in price level and in general costs supervened on the rise in export prices. Between 1946-47 and 1947-48 the retail price index rose by 7

¹⁷ Some comparison of movements in the Australian retail prices with retail prices in other countries may be illuminating. I give the figures for December 1949 and December 1952 as being the years of "the great inflation" in Australia. In all cases the base is 1937 = 100.

	Retail Prices	
	December 1949	December 1952
Australia	168	233
New Zealand	146	179
Canada	160	189
United States	164	184
United Kingdom	183	212
West Germany	156	170

per cent; between 1947-48 and 1948-49 the increase was 9 per cent and between 1948-49 and 1949-50 9 per cent also. These increases were in themselves disturbing, but during this period export prices had risen by 90 per cent. It is a reasonable assumption that even in this period the rise in export prices was a much stronger inflationary influence than the pressure of investment. So I think it is fair to assume that if the impact of rising export income on the economy could have been mitigated, it would have been possible for the Australian economy to proceed with its high rate of development and expansion without much greater an increase in prices and costs than that which occurred in Canada or the United States.

A further controversial matter was the effect of the automatic adjustment of wages to the cost of living. Under the Australian system of wage control all wages subject to federal court awards carried the provision for automatic adjustment to the quarterly movement in the retail price level.¹⁸ This practice had been extended very considerably after the war and had included many salary earners whose incomes were not the subject of court awards. It was argued that the rise in the cost of living brought each quarter a rise in the level of money wages, and that this in turn caused prices to rise, and so on and on in a never-ending spiral. This argument is much too simple, and it ignores the basic forces that control movements of prices and costs in the Australian economy. The problem can be considered in the same light

¹⁸ The Commonwealth Court of Conciliation and Arbitration gradually extended its scope of activities over workers "in industries extending beyond the borders of one State" until it became in the twenties the principal, though by no means exclusive, industrial tribunal. It was customary to insert in an award a provision under which the basic or minimum wage was to be varied each quarter by an amount announced by the Registrar of the Court on the publication of an index of retail prices prepared for the Court by the Commonwealth Statistician. Hence the term "automatic." No special hearings were required, the mere announcement being sufficient to guide the parties. The practice was abandoned by decree of the Court in September last when giving decision in a lengthy and fundamental case brought by certain employers seeking (a) reductions in wages, (b) increases in working hours, (c) abandonment of the "automatic" adjustment. Only (c) was granted by the Court, and this decision in many respects was much more startling than if a substantial change had been made on the grounds of either or both of (a) and (b). It removed one of the distinctive features of Australian wage fixation, but the Court has indicated that it is prepared to consider reviewing the wage annually in the light of circumstances.

as the impact of export income, or indeed any new income from investment or other sources, upon total income. Thus, an increase in the basic wage of, say, 10 per cent would not cover all wage earners so that the added cost to the economy on account of wages would not be 10 per cent, perhaps 8 per cent. Thus, in the first instance, the increase in costs and prices, even postulating a closed economy, would be less than the rise in the basic wage itself, but wage costs are only a part of total costs. We may put the problem this way. Taking the figures of national income for 1949-50, wage and salary earners received £1,197m out of a total gross product of £2,724m, or approximately 45 per cent. Hence it follows that whatever the increase in cost brought about by the adjustment in the wages, only 45 per cent of it would be effective immediately in adding to costs in industry as a whole. For this reason, therefore, the original 10 per cent, which I suggest should be reduced to 8 per cent, would work out at 3.6 per cent. Other considerations, which need not be dwelt upon in detail here, might bring the figure down below 3.6 per cent. We may take 3.6 per cent as the maximum first increase in costs over the whole economy resulting from a rise of 10 per cent in the basic wage. The cost of living we may then assume would rise by 3.6 per cent, and another increase in the basic wage would follow of the same amount. But this would result in an increase in costs, not of 3.6 per cent, but as in the previous case of a little more than one third of that, say 1.4 per cent. That would be the second impact. The third would start with a wage increase of 1.4 per cent, giving rise to a third impact of 0.5 per cent increase in costs. It would either not be necessary to adjust the basic wage to this rise, or if such an adjustment were made, the fourth impact on costs as a whole would be negligible, and the movement to higher costs would evaporate. Thus it is not true in a closed economy that the wage-cost spiral would be self-perpetuating, or that costs would rise *pari passu* with prices. On the above assumptions, the actual increase in over-all costs caused by a rise in the basic wage of 10 per cent, and allowing for subsequent automatic adjustments, would be of the order of 6 per cent as a maximum if the repercussions were to be permitted their full operation.

It is quite clear that the Australian economy is not a closed economy; indeed, in spite of the restrictions on trade and financial transactions, it

remains one of the most open economies in the world because of the impact of rapidly changing export and import prices, and the high proportion of external trade to internal production. Import prices themselves will, of course, operate to raise costs but imports do not exercise the same original generating force that exports do. Nevertheless, the rise in import prices was substantial, being from 232 in 1946-47 to 309 in 1949-50, or 33 per cent. The increase was at a greater rate in the following two years, from 309 to 418 or 35 per cent for the two years. But variations in import prices have to work within the framework set by the balance of payments and the level of export income in relation to costs. An unfavorable balance of payments and an adverse movement in the ratio of costs to prices in export production reduces the demand for imports, and even though prices of imports may rise, the impact of this rise on the economy would be mitigated by the reduced demand. On the other hand, if export prices are rising at a greater rate than import prices, and the balance of payment is favourable, and the ratio of costs to prices of export production are moving in favour of the export producer, the demand for imports will rise and the impact of the higher prices of imports on costs will be proportionately greater. It is desirable, however, to emphasize again that the import price level is not as vigorous a generating force on changes in income and costs and prices as is the movement in export income.

11. INCREASED IMPORTS AS A COUNTER TO INFLATION: BALANCE OF PAYMENTS CRISIS

This point is important because there was a school of opinion that held the view that the inflation could be corrected by bringing in more imported goods. This view had considerable influence on official policy for a time, and every encouragement was given to increasing the imports of goods like steel, pre-fabricated houses and capital equipment. This attitude followed from the frequently repeated story that inflation was brought about by "too much money chasing too few goods," a simple and facile expression of a much more deep-seated malady. In the circumstances under which inflationary pressure is registered in increased prices, costs, incomes, and spending power in Australia, there is always the danger, after a period, of imports rising rapidly

and bringing about a serious balance of payments problem. If one could assume that the level of imports could be considered in a vacuum and one could obtain imported goods at reasonable prices, it might be a tenable view that the inflationary impact of export prices or other forces could be dampened down by flooding the country with imports. Neither of these assumptions was true and there are practically no circumstances in the history or the working of the Australian economy in which they could be true. As it happened, the prices of imported goods, particularly of capital equipment, were very high, much higher than the prices of local supplies where they were available. Hence, if the prices of imported goods were given free scope, they would exert for the time being a considerable inflationary influence, but it would be only for the time being, because the policy of unduly stimulating imports would soon bring about difficulties in the balance of payments. This is precisely what happened in the Australian case, and it was not unforeseen by those who had some experience of the working of the Australian economy. If we take the period 1948-49 to 1952-53, we get the following movements in exports and imports:

TABLE 6

	Imports	Exports
	(Figures in £m.)	
1948-49	415	522
1949-50	538	594
1950-51	742	975
1951-52	1050	675
1952-53	514	872

There is nothing unusual in the history of the Australian economy in the marked changes shown by these figures in the level of imports and exports, except perhaps the record level of imports in 1951-52, and the greatly improved export level in 1952-53. The former was due in part to the normal expansion of demand for imports when incomes are high in Australia, in part to the dispatch of delayed orders from the United Kingdom when other markets were adverse to her, and in part to the deliberate policy adopted by Australia of encouraging imports. The effect was to produce an adverse balance of trade of £375m. When, however, the other items in the balance of payments are taken into account, the adverse balance for 1951-52 reached the remarkable total of £576m. *Facilis descensus Averno!* Australia's

international balances fell from £843m at the end of June 1950 to £362m at the end of June 1952.¹⁹

Early in December 1951 I had forecast a deficit in the balance of payments of £425m for the year 1951-52. This was regarded as a quite excessive figure and the policy of permitting large imports and even encouraging them was continued until the beginning of March, when it was suddenly reversed.²⁰ Very severe import restrictions were imposed and the level of imports brought down to a rate of approximately £500m a year. One effect of this drastic action was, of course, to make the stocks of imported goods liquid. These goods had been brought in at high prices and so the policy of import restriction, inevitable in the circumstances and the more severe because of the delay in taking action, was to sustain the high level of costs that had already been reached. Thus, the assumptions behind the view that inflation could be corrected by larger imports fell to the ground. It had exactly the opposite effect in that it consolidated a position of high costs, when a more moderate import policy and earlier action would have avoided such severe restrictions, and left importers to assume some of the risks of their own folly. The position was to recover much more rapidly than anyone anticipated because of the very satisfactory volume of exports of 1952-53 and the maintenance of the price of wool at 6/8d a

pound. Under the impact of these favourable forces and the controlled lower level of imports, there was a great improvement in the balance of payments and Australia's international reserves rose by £186.2m in one year, to bring them to the reasonably comfortable figure of £548m at the end of June 1953.

From this analysis one concludes that the level of investment, the automatic adjustment of wages to the cost of living, the impact of imports on the economy could not be regarded as the prime causes of the rapid increase in prices and costs in the years 1950-51 to 1952-53. The prime cause was in fact the very high export prices, and the rapid increase in export income and the spending power of export producers. This point was fully expounded during the expansionist movement of the 1920's and the depression of the early 1930's. I have already referred to the analysis made by the Committee on the Tariff and published in *The Australian Tariff: An Economic Enquiry*, but the lessons of this study seem to have been forgotten. The war removed the Australian economy from the normal impact of external forces, and the vastly improved terms of trade in the early post-war years left an impression of undue security against the impact of outside forces. It is clear now in retrospect that nothing has happened in the post-war years to alter the operation of export income upon the income level, the cost level, and the international reserves level. These three are all inter-related and unless some direct action is taken to mitigate variations in export income, it will continue to have the same disturbing influence upon the economy as a whole as it has had in the past. One only needs to look carefully at the events of the post-war period to see how vital a force export income is in the Australian economy. Indeed, the last three years provide almost a model case study. Nothing happened in these years to the basic influences controlling the Australian economy that were not equally discernible in, say, the period from 1926-32.

¹⁹ Figures for Australia's international reserves in the post-war period were as follows:

End of June	£Am.
1946	215.4
1947	198.7
1948	273.5
1949	451.7
1950	650.1
1951	843.0
1952	361.9
1953	548.1

For the end of June 1939 the balances were only £55.7m. Prior to the war it was thought that balances of about £80m were required to provide the necessary cushion for variations in prices, volume of export production and other hazards that affect the balance of payments. In the conditions of the post-war world, bearing in mind the greatly changed price level and the more disturbed trading conditions, it would be reasonable to take £400m as the figure providing the necessary security.

²⁰ Public statement of December 11. In the event the adverse balance on current account was an all-time high of £585m, compared with a favourable balance of £101m in the previous year. The adverse balance, allowing for capital movements, was £481m in 1950-51 and the favourable balance in the previous year £190m, as shown in the figures for international reserves in the last footnote.

12. COMMODITY STABILIZATION: AN EXPORT LEVY ON WOOL AND METALS

Having established the point that the most vigorous inflationary force was the rise in export prices, and particularly the rise in wool and metal prices in the middle of 1950, the question arises as to what the government could have done to check the impact of rising export income upon the econ-

omy. The most obvious single contribution would have been a stabilization levy upon the gross income from wool and metals. I proposed such a levy in September 1950.²¹ It was to have taken the form of a one-third deduction of the gross income of wool growers. The proceeds were to be placed in a wool stabilization fund to be managed jointly by the government and the growers. The percentage deduction could have been varied up or down according to the movement in the wool market; and, in fact, a levy of 40 per cent of gross income would not have been out of place in the circumstances. I further suggested that two-thirds of the fund so established should be held in trust for the growers, to be repaid as and when wool prices declined, or costs of production became embarrassing to the wool growers. The remaining third of the fund was to be ear-marked for national expenditure on rural betterment. This would have been entirely appropriate in the circumstances of 1950-51 when wool reached such a fabulous price. Inherent in the proposal was the provision that wool growers should not be taxed on the amounts allocated to the stabilization fund until it became part of their normal income on being refunded. Little explanation is needed to show that this would have been in the long term interests of the wool growers because their taxation would have been much lighter. As regards the fund for betterment, if one third had been taken from the gross income of £636m for the whole stabilization fund, over £200m would have been put in reserve. Of this amount, the sum to be held in trust for rural betterment would have been £65m. It requires little imagination to see how important such a fund would have been in respect of community facilities for libraries, cultural activities, assistance to such bodies as the Country Women's Association, the promotion of research and, above all, the establishment of rural universities.

Unfortunately, the proposal met with the most violent opposition of the wool growers, who held that this would be a grave interference with their freedom of enterprise and a first step towards government control of the industry. In retrospect, it can now be seen that the proposal would have been greatly to the long term benefit of the growers, as well as of benefit to the whole working of the national economy. As regards the interests of

the growers, it can be assumed that their payments in taxation would have been substantially less than in fact they were, that their costs would have risen considerably less than they did, and that they would have themselves avoided some of the more extravagant forms of expenditure which inevitably accompanied the receipt of incomes that no grower ever expected to earn. As regards the economy as a whole, the spreading effect of higher export income would have been dampened down by insulating, as it were, a substantial proportion of the gross export income. This would have dampened down the inflationary impact of high export prices and local costs and would have avoided the worst features of the balance of payments crisis which supervened in 1951-52, and was in part due to the special features of the anti-inflationary policy made necessary because measures taken to reduce the impact of high export prices were far less effective than the stabilization fund would have been.²²

13. THE ALTERNATIVE OF CURRENCY APPRECIATION

An alternative proposal that had much support at the time was the appreciation of the currency.

²² The possibility of currency appreciation led others than wool growers to oppose the stabilization proposal, especially when they thought that their immediate interests would be promoted by a rise in the international value of Australian currency. There were political cross-currents. As action was urgent the controversy between one alternative and the other was fatal. With the advance of the export season considerable initial damage was done, and then it could be argued that it was too late to adopt the alternative. Such are the obstacles, political and otherwise, to the adoption of any drastic measure of economic policy. Confusion was worse confounded by differences among both official and academic economists. In war time there is the sanction of national urgency, but in peace the day to day conflict of pressures too often discourages action, especially when no single clear line of action is acceptable to powerful groups. In these circumstances economists cannot presume to have any special position of influence, especially when they speak with conflicting voices. Too much should not be claimed for the export levy as a counter to inflation because the psychological effects of wool at 12/- per lb. would still have been a powerful force and some considerable rise in incomes and spending power as a whole would have been inevitable. This might have been countered by strong fiscal measures such as were taken in the following year. Backed by the appropriate fiscal policy, the stabilization plan was, in my opinion, the most important single anti-inflationary measure that could have been taken at the time, and the one that would have involved the minimum control and disturbance to the economy.

²¹ See my *Expansion and inflation: essays in the Australian economy*, Melbourne, Cheshire, 1951. pp. 82-89.

Certainly the restoration of parity with sterling, and no other move in the rate was practicable at the time, would have had a strong anti-inflationary influence. It would have reduced the gross export income in money terms as well as softened the impact of rising export prices upon local costs. There was much popular support for this proposal, even among the wool growers themselves. For one thing, it had some appeal on grounds of respectability. It would restore the Australian pound to parity with sterling and thus repair the supposed damage done to prestige when the currency was depreciated in 1931. There were, however, two rather serious obstacles to the proposal. In the first place, there were vast differences in the earnings of export producers, and there were certain problems associated with the long term contracts with the United Kingdom for dairy products, meat and wheat. The appreciation of the exchange would have fallen severely on many export producers, particularly those producing dairy products, meat, dried fruits and a number of others of less importance. As I expressed it at the time, "it would have fallen on the just and the unjust alike."²³

Moreover, the appreciation of the exchange to, say, parity with sterling would not have been sufficient to counteract the very high prices of wool and metals. The Australian pound had been at the rate of £125 to £E100 and the restoration of parity would have involved a maximum reduction of 20 per cent only in the export income from wool and metals. This was not sufficient in the circumstances for these industries, but a reduction of 20 per cent in the gross income of other export industries would have been too severe. It would have had to be accompanied by a revision of the prices in the long term agreements with the United Kingdom, so that the existing prices in Australian pounds would have remained stable. In that event it would have been the British consumer or the British government who would have met the cost of the depreciation, and not the Australian producer.

The second and even more serious, though less obvious, ground for objecting to the proposal was that an appreciation would have involved appreciating the Australian pound in terms of dollars.

²³ This and other matters connected with the proposal to appreciate the exchange were dealt with in an address delivered in Sydney in April 1950 and published in my *Expansion and inflation: essays on the Australian economy*, Melbourne, Cheshire, 1951.

Clearly, Australia has been in no position since the war to make her currency more expensive in terms of dollars. Very severe import restrictions were in operation, having been increased by 25 per cent only as recently as the third quarter of 1949. In the long run, the appreciation of the pound would have necessitated further restrictions on dollar imports, and would have in general imposed greater controls on the economy, and postponed still further the day when the Australian pound might become freely convertible into the hard currencies of the world. This objection would not appeal to those who feel that any course involving greater control of the economy is not in itself a bad thing. For my part, I viewed with increasing concern the tendency to choose a course that must end in stronger measures of control. This, however, is much more a matter of social theory than of economic theory, and all the evidence of both the theory of international exchange, and of the attempts made by countries to hold their currencies at appreciated levels in terms of other currencies was against any policy embracing currency appreciation in Australia in 1950.

14. THE ACTION TAKEN: PREPAYMENT OF INCOME TAX AND CREDIT RESTRICTION

Because of political controversy, both the appreciation of the pound and the proposal for a stabilization fund were rejected by the government after protracted discussion. The government fell back upon a proposal under which wool growers were to pay a levy of 20 per cent on gross income representing the payment of their income tax in advance. This system of pay-as-you-earn was, of course, quite familiar to all salary and wage earners in many countries. It was imposed on the wool growers in order to establish some check upon excessive expenditure arising out of the very high incomes they were receiving. No doubt it was a contribution in this respect, but it was far from adequate to meet the situation. Even this mild form of contribution was received with violent opposition from the industry. Such is the political and social background in which governments at times have to adopt the more enlightened teachings of modern economic theory. There was not the active support from economists for the stabilization fund that might have been expected. This is strange in view of the fact that commodity control plans received much attention in the war time discussions of economic measures designed to provide a more stable economy after the war. In-

deed, it is impossible to imagine the economy of a country like Australia acquiring a greater measure of economic stability unless some form of commodity stabilization is adopted. The conditions of 1950-51 were almost the ideal conditions under which the proposals for stabilization could have been applied to wool and to metals.

It would be absurd to suppose that the direct attack on stabilizing export income would be sufficient to deal with all the inflationary pressures that had been developing in the Australian economy since the fiscal year 1946-1947. Other measures were necessary and some of these were taken, though rather after the event. The two most important single measures were credit policy and fiscal policy, though neither of these could have been sufficient in the circumstances of 1950-51 to deal with the impact of export income. Nevertheless, they were both important in that they did operate upon the level of investment and more particularly on consumer spending.

As regards credit policy, the Australian banking system had developed a technique during and after the war under which the reserves of trading banks were in effect automatically stepped up during a period of inflation and expansion and their power to expand credit controlled. This technique was developed in the war to avoid the repetition of the credit policy of World War I.²⁴ It was arranged

²⁴ This was known as "the special account" system because of the compulsion on the part of the trading banks to place surplus deposits in a special, non-interest-bearing account with the Commonwealth Bank as the central bank. They were frozen reserves to be released at the discretion of the Commonwealth Bank. By 1946-47 they already amounted to £265m. Thereafter they moved as follows and I give the deposits and advances of the trading banks for purposes of comparison.

	Australian Trading Banks		
	Special Accounts (£m)	Deposits	Advances
1946-47	265	636	261
1947-48	262	673	310
1948-49	322	776	368
1949-50	377	910	404
1950-51	500	1,144	479
1951-52	466	1,201	621
1952-53	212	1,162	638

In 1938-39 before the special account system, deposits were £318m and advances £288m. This would give a ratio of about 90 per cent of advances to deposits, perhaps a little higher than the normal pre-war figure that fluctuated around 87.5 per cent. The post-war picture is very different with deposits on the average more than double advances. Other features of this table are discussed later in the text.

Important amendments were made in "special account"

at first in agreement with the trading banks in 1940 that they would hold in a special account all increased deposits above a certain figure. Thus their advances policy would be limited to the amount that it would be prudent to advance on the basis of deposits at the agreed date. These special accounts were kept with the Commonwealth Bank as the central bank, and were in effect part of the reserves of the banking system. Later in 1942 these provisions were made compulsory by regulations under wartime powers and they were embodied also in the amendments to the Commonwealth Banking Act of 1945. In addition, the Commonwealth Bank was empowered to lay down basic conditions from time to time for the credit policy of the banks. In doing so, the Governor of the Bank was obliged to carry out the policy suggested from time to time by the Commonwealth Treasurer. Thus the government, with the central bank, had at its disposal strong powers to impose a credit policy designed to counteract inflationary influences. This policy was put into force late in 1950 and, apart from the levy for the prepayment of income tax by wool growers, it was the only fresh anti-inflationary device adopted at the time. It was not until the opening of the fiscal year 1951-52 that more severe counter-inflationary measures were taken. These were embodied in the Budget for the year 1951-52.

15. THE APPLICATION OF FISCAL POLICY

This Budget was the first major application of fiscal policy to deal with the inflationary situation. After discussing the several measures that could be taken, such as "special account procedures, advance policy instructions, capital issues," the Treasurer, in his Budget statement, declared that "by far the most effective action a government can take is through its Budget." In the light of the above discussion, it may be doubted whether "the most effective action" was in fiscal

procedure in the banking legislation of 1952. A new basic figure for the accounts was fixed at the actual level of accounts on October 10, 1952, and 75 per cent of any increase in deposits over the level of September 1952. This is subject to an important proviso under which the maximum amount any bank may be required to place to special account in any year will be the actual amount in the previous September plus or minus 75 per cent of a rise or fall in deposits since the preceding August. The special accounts at the basic date, October 10, 1952, amounted to £172m for the fourteen trading banks, inclusive of the Banking Division of the Commonwealth Bank as separated from the central bank by the 1952 legislation. See Commonwealth Bank Report 1953.

policy, unless the Budget included specific provisions for stabilization of export income. However, that problem did not arise in 1951-52 because wool prices had fallen, and for the year 1951-52 they were 73d per pound as compared with 144d per pound in the record year. They were, however, still very high at 73d although they had fallen by nearly 50 per cent from the high level of 1950-51. However, the Budget of 1951-52 was a serious attempt to apply fiscal policy to the task of counteracting inflation. It became known among the Opposition as "the calamity Budget," thus again illustrating the pitfalls that confront a government when it attempts to use its budgetary powers to check inflation and expansion.

The measures adopted in the Budget were certainly drastic in terms of any previous experience. The Treasurer aimed at producing a surplus for current expenditure, even though the Budget provided for an expenditure of over £100m for Commonwealth public works, and at reducing the level of public investment. Neither measure was calculated to evoke a popular appeal. As regards the Budget surplus, new taxation was imposed to produce an added income of £160m, bringing the total revenue to £1041m, and the estimated surplus to £114m. The increased taxation was spread over direct taxes, income and company profits, and indirect taxes on commodities through the sales tax. All of these were designed to reduce current consumption. Public borrowing for works for the States was limited to £225m, representing a reduction of 25 per cent in the requests of the States for loan expenditure. As already mentioned, this was the first Australian Budget which set out deliberately to employ "surplus" finance as an anti-inflationary measure. There is no doubt that it had some of the desired effect, but it is unfortunate that it was not produced a year earlier. As it happened, the anti-inflationary Budget coincided with a substantial drop in wool and metal prices and a reduction in exports, including gold production, from £988m in 1950-51 to £678m in 1951-52. It is somewhat ironic to suggest that the drop in exports and the stringency about to be caused by the adverse balance of payments were perhaps more deflationary in their influence than were the measures contained in a Budget that was bound to create a great deal of opposition. This would be a rather jaundiced judgment. The Budget must be considered in relation to all other measures, and in particular to the check given in the Budget

to public investment, to the operations of the special accounts of the trading banks with the Commonwealth Bank and to credit policy of the banks as determined by the government through the Commonwealth Bank. The Budget put a limit of £225m on the works programmes of the States, and this was the subject of even more controversy than were the increases in taxation. The Treasurer justified his action on the ground that "the greatest need for a revision of current ideas about what is good and timely lies in the field of public works." This amount was to be underwritten by the Commonwealth, because the market was in no shape to absorb any substantial volume of public borrowing. The sum was actually 36 per cent in advance of the amount spent in the previous year, but 25 per cent below what was urgently sought by the State Governments to enable them to proceed with a volume of works that had now expanded without any considered plan for the country as a whole. The decision meant some revision of programmes and some works were temporarily suspended. Since the volume of public investment is itself one of the determinants of total investment under Australian conditions, and there was a growing stringency in the money market, this action also had the effect of imposing some check on private investment which reached a high peak of £770m, exclusive of movements in stocks, in 1951-52, and fell to £697m in the following year. The proportion of total fixed investment to gross product was brought back 26 per cent from its high peak of 29 per cent in 1951-52. It was still high at that figure and it may be doubted whether such a ratio can be sustained without much greater recourse to external capital than is current practice.

Bank advances reached their highest point at £699m in July 1952 compared with £528m a year earlier. As is always the case, a bank restriction policy is selective, and in the current difficulties a substantial increase in advances to finance imports and stocks was necessary. The special deposit accounts ran down from £570m at June 1951 to £303m a year later, and a low point of £156m in December 1952. This was in part a phenomenon of the balance of payments difficulties, and in part the deliberate policy of the Commonwealth Bank to keep the banks liquid. This policy on advances and reserves had the effect of damping down investment without causing serious financial problems for industry or government, so that the ad-

justment to a lower tempo was made in an orderly manner, and a grave balance of payments crisis surmounted without financial disturbance. Behind it all, was the weapon of import restriction which created certain long term problems not yet resolved. The policy left costs at a very high level and it is still a question whether this level of costs is economic and capable of being sustained without some other adjustment.

The recovery of the export income was unexpectedly good in 1952-53 and is still being sustained, thanks to a favourable price for wool around 7/-per lb., and a high volume of exports of agricultural goods. The level of London funds rapidly recovered to a sound position at £548m in June 1953, and there is every reason to suppose that there will be a further improvement in the current year. There was no great disturbance to employment as a whole, though some industries, such as textiles and light engineering, had difficulties. Employment, other than rural and defence, was at a high point of 2,627,700 in January 1952 and had fallen to 2,522,000 a year later; thereafter it began to recover, and the relatively small amount of unemployment to decline. Finally, the price and cost structures were brought under control. Retail prices acquired a high degree of stability after the middle of 1952, compared with their continuous and substantial increases for the three years before. Costs of production were on the whole reduced, thanks to greater output per man-hour, reduced labour turnover and improved management. Production in essential industry caught up with demand, and in some commodities, such as coal and steel, surpluses began to emerge.

To attribute these more favourable developments to the fiscal policy of the 1951-52 Budget would be claiming far too much. This Budget undoubtedly reduced spending power and brought investment more closely into line with both money market conditions and available resources. But it was accompanied by a decline in export prices and later by an unexpected increase in the volume of export production, with the reduction in imports brought about by reduced demand and import restrictions. The balance of payments rapidly improved and this eased the monetary restriction at a time when some reduction in costs was being achieved. For all these reasons, fiscal policy had a satisfactory base on which to operate, and there can be little doubt that the economy was more stable at the end of 1952 than at any time since the war.

16. A HIGH RATE OF DEVELOPMENT

Reviewing the varied fortunes of the Australian post-war economy, the uneconomic distribution of resources, the inflationary pressures and the instability tend to obscure the real achievements. Despite all the apparent disorder, the period from 1947 to 1952 was one of extraordinary expansion, whether we consider this in relation to the previous history of Australia, or to the current rate of economic expansion in the Western World. Australia has not been a recipient of assistance in any sense of the term in this period. On the contrary, she has been a contributor and has been accepting greater international responsibilities, particularly with reference to her immediate geographical environment. Australia has absorbed, relative to her existing population, a higher percentage of migrants than any other country in the Western world, even including Canada. Since the war she has taken 750,000 people from the United Kingdom and the countries of Western and Central Europe, and she is continuing with a migration programme that would have been regarded impossible even ten years ago. Despite the difficulties she encountered in 1951 and 1952 immigration was never less than 80,000 per annum, and this was more than double the maximum number of migrants Australia received at any period in her previous history.

The rate of investment relative to the gross product of the economy reached levels far in excess of those operative before the war, and approached the very high levels attained by the Canadian economy. At no period in Australia's history has the rate of investment and construction been so high as in the period from 1947 to the present time. As indicated earlier, this was assisted by the inflow of private capital, and is in part dependent upon some foreign capital on public account. But this is also true of the Canadian economy, where the great expansion of recent years has been supported, not only by the high level of savings in Canada and the increased productivity, but also by a steady inflow of "risk" capital from the United States. In the Australian case the inflow of capital needed to sustain a high level of immigration and development is much more directly related to public investment than to private investment. This is due to the fact that in Australia a higher proportion of power and transport development and of housing is based upon public rather than private enterprise. This

has been the traditional pattern of development in Australia, and loans raised abroad on public account have been a good investment for both the borrower and lender. One of the difficulties now confronting the Australian economy is that, in spite of this record, the facilities for raising capital overseas on public account are much more restricted than they were in the nineteenth and early twentieth centuries, when the British money market was able to supply the necessary capital. Perhaps the strongest force restricting the development of Australia in the next decade will be the changed circumstances of overseas capital supply brought about by the inability of the United Kingdom and the sterling area to supply capital on the familiar pattern, plus the inability or unwillingness of the dollar area to meet the legitimate needs of a country requiring capital for sound economic development and appropriate immigration needs at a reasonably low rate of interest. If this capital is not forthcoming and the rate of development has to be toned down, many will consider it the fault of Australia because of the apparent instability of the Australian economy. In fact it will be the fault of the outside world, and in particular of the United States, because of their obsession with the short term instability of the Australian economy and their neglect of the long term plans upon which economic development and economic policy in Australia have been based in the post-war period.

17. RETURN TO TRADITIONAL POLICY

Nevertheless, it must be admitted that, in respect of one of the basic features of economic policy since the war, Australia has fallen between two stools. I refer in particular to the problem of control. It will be clear from the analysis of the development of the economy since the war that there was a certain naive belief in control without a clearly defined plan being enunciated, or an administrative structure for control in a federal system being developed. The controls that were favoured and sustained after the war placed undue emphasis upon defence against insecurity and instability. It was assumed that the American economy would be unstable, and that after the teething troubles of the transition from war to peace there would be a period of possibly two years of relatively boom conditions, to be followed by a severe depression.

There are two predominant themes in the in-

terpretation of history—the one is that history never repeats itself; the other is that we learn from history that we learn nothing from history. On both these maxims Australian “planners” were wrong. If it were true that history never repeated itself, then it was quite wrong to have assumed that the experience of 1921 or even of 1930 would have been repeated. This, however, is precisely what many of the Australian advisers did assume. On the other hand, if it were true that we learn from history that we learn nothing from history, then they were equally wrong. If they had adopted this maxim as a guide to policy, they would have taken a chance on the pioneer spirit and would have assumed the appropriate risks. This would have involved internal policy based confidently upon the future expansion of Australia, and an external policy based equally firmly upon an association with the most vigorous economic forces of the outside world. In fact, neither of these conditions was met by Australian economic policy. Internal measures were taken to safeguard the economy against both insecurity and instability. Thus emphasis was placed upon the control of investment through capital issues, the control of prices, the control of banking policy, the maintenance of a low rate of interest and the expansion of social services. Externally, the chief objective of policy was to rely upon past associations with the United Kingdom for the marketing of export products, the sale of a substantial proportion of Australian exports on long term contracts with the United Kingdom for fixed prices, and the restriction of imports from the dollar area in order to sustain the sterling area. In all these respects, both internal and external policy gave predominant emphasis to defence against risk and instability. The older weapons of free exchange dealings, open operations on the money market, determining a competitive rate of interest and adjustment of the economy to variations of the balance of payments were discouraged for the time being. That was possible, in major part, to the special circumstances of the immediate post-war period, when terms of trade and the balance of payments were favourable and there was a steady and persistent rise in the level of international reserves of the Australian banking system. In these circumstances it was possible to sustain a low rate of interest, and to permit a rising level of costs without immediate embarrassment, but in the end the policy was bound to run against the tra-

ditional obstacles of easy money, high costs, and unduly ambitious developmental plans.

This is what happened in 1951. As has already been shown, the only novel feature of the post-war experience was the emergence from the difficulties of 1951 and 1952 without a major internal financial crisis. This was due in large part to the unbridled recourse that was had to the weapon of import restrictions, and in part to the very fortunate turn of events in the latter part of 1952, when wool prices held their position in a quite unexpected manner, and the volume of export production rose in an equally unexpected manner. But it left Australia with a very high level of costs relative to the outside world, and no obvious means of solving the problem should wool and other export prices fall, or the volume of export production be reduced by adverse seasons.

So considering the whole position, the post-war experience has once again emphasized the importance in the Australian economy of export income, and in particular of the price and the volume of output of wool. Variations in export income remain the most volatile influence in the Australian economy, and if any single measure is to be taken to promote stability it should be taken with some scheme of price stabilization or "buffer stocks" for leading Australian exports.

Next to this is the importance of an inflow of foreign capital for developmental purposes. This again, is in accordance with the Australian traditional pattern. Australia has always absorbed a large measure of foreign capital on public account for its economic development. It would have been supposed that the less freely and more emphatically private enterprise nature of the international economy of the nineteenth century would have made it more difficult for Australia to obtain this capital than at the present time, but this is not the case. For the moment there is no obvious source of foreign capital available to Australia for her urgent and quite legitimate needs for economic development. Australia is not altogether immune from criticism in this matter. It was assumed in the early years after the war that Australia should avoid making any commitments for public borrowing, though at the same time the Commonwealth Government entered into heavy commitments for immigration and development. It is now quite clear that these plans cannot be sustained unless an increasing supply of foreign capital is available. This is strictly in

line with the whole tradition and experience of Australia.

Next, one might refer to the part that monetary policy and the rate of interest plays. The expansion of Australia depends not only upon foreign capital, but also upon the ability of governments and public authorities in Australia to raise funds upon the local market. It was assumed in the inflationary period after the war that these funds would be available continuously at low rates of interest, and that there was some legerdemain in banking policy that would enable a government to obtain increasing loans on the money market without considering the rate of interest as a factor that would itself be influenced by rising rates abroad or rising prices at home. The experience of the last three years has indeed shown that if any of the elements for free economy are to be sustained, the rate of interest is an important factor, registering changes in price levels, the demand for capital and the fluctuations in the balance of payments. So on this ground also we have to return to the traditional pattern of Australian experience.

This leaves perhaps the most fundamental of the short term influences controlling the fortunes of the Australian economy. During the war and for six years after the war there was little need to worry about this factor, because the war-time circumstances guaranteed sufficient London funds, and the immediate post-war circumstances ensured a steady, and at the end a remarkable, increase in London funds. But the crisis of 1951-52 brought Australia back to earth on this old problem. It was then clear that the Australian economy could not live in a vacuum, that the level of London funds was the strongest of the short term influences upon the money market, banking policy and the capacity to absorb imports.

I have shown above that this situation was met in a way that was not open to the authorities who had to meet it in the previous history of Australia, but there can be little question that it is now realized that the balance of payments and the level of our international resources remain a determining influence upon the limit to which internal policy can be pursued on the assumption that we operate in a closed system. Here, again, we return to a traditional pattern.

Finally, there is the problem of costs, and this is the indeterminate question of the moment. As was indicated in the previous section, Australia

came through the recent financial crisis without any great internal disturbance. It was helped by a more enlightened fiscal policy, by recourse to the weapon of import restriction, by the changed conditions in the banking structure due to the device of "special accounts," by a swift and unexpected recovery of both the volume and prices of exports. But it remains true that the cost level

which was preserved by this extraordinary and fortuitous combination of circumstances still leaves the Australian economy vulnerable to any adverse movement that it may encounter. It is not a pleasant prospect—but fortune favours the brave, and, as it turns out, the development of Australia since the war has shown that there are still more of the brave than of the planners.

A HALF CENTURY OF AERONAUTICAL RESEARCH

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(Read November 13, 1953)

INTRODUCTION

ON THE Golden Anniversary of man's first controlled flight at Kitty Hawk, we look back over a half-century of rapid advance in all fields of science and technology. During this period radical changes have taken place in the relation between science and technology. Fifty years ago science was mainly concerned with discovering the universal laws of nature, formulating concepts, devising theories, and gaining understanding in unexplored areas of knowledge. Scientific activity had little direct contact with practical affairs. Technology, based on the experience of past generations, embodied mainly a store of knowledge accumulated empirically. It advanced by cut-and-try methods and by the contributions of individual inventors and skilled craftsmen. Today science and technology are so interrelated and interdependent that it is sometimes difficult to tell where one ends and the other begins. Practical development reveals the need for new scientific knowledge in particular fields, and scientific results in turn guide further development.

The source of new scientific knowledge is research, the critical investigation and experimentation having for its aim the discovery of new facts and their correct interpretation, and the revision of accepted conclusions, theories, or laws in the light of newly discovered facts. Early in the present century the General Electric Company, recognizing that "scientific knowledge is the most important raw material for engineering development" and that engineering progress depended on a continuing supply of such new knowledge, founded the first industrial research laboratory. This example was soon followed by others, and research is now the indispensable element in assuring continuing industrial achievement.

Aeronautical research has influenced and has been influenced by contemporary developments in many fields of science and technology. Its contributions to the progress of aeronautics exemplify the power of research as a tool of technologi-

cal progress in all areas. The most fruitful results of research from this point of view are new concepts which not only correlate and classify existing knowledge in a comprehensive rational pattern but which also suggest new goals and methods of achieving them. For example in 1929 Sir Melvill Jones pointed out from existing information that airplanes were using about three times as much power as would be necessary for an ideal streamline airplane in which the air flowed smoothly over the wings, body, and tail without separation and turbulence. While at the time aircraft designers did not believe that the performance of the ideal streamlined airplane ever would be achieved, it was in fact achieved in about twenty years as a result of intensive effort in applied research.

The first half-century of aeronautical research has brought forth many new concepts and the talk and thinking of designers of today contain many new technical terms describing them. The concepts of boundary layer, laminar flow, turbulent flow and many others did not always exist. Guided by them, applied research workers and designers are stimulated to look for further improvement. These fruitful concepts were not in existence when Wilbur and Orville Wright designed and built their first flyer.

AERODYNAMICS IN THE FIRST HALF-CENTURY

If any branch of science is to be considered dominant in aeronautics it is aerodynamics—the study of the flow of air and the forces exerted on bodies moving through it. Activity in this science long antedates Kitty Hawk. Aerodynamic theory had a beginning in 1687 with Newton who regarded air as made up of small particles moving independently. He derived a formula for the force of the wind on inclined surfaces which persisted in handbooks and other publications long after experiment had shown it to be seriously in error.

For centuries aerodynamic theory developed in a mathematical environment as little affected by the experimentalists and inventors as they were influenced by the existence of such theory. The theory of a perfect fluid without friction was developed by Bernoulli, D'Alembert, Euler, and Lagrange in the eighteenth century. Further advances were made during the nineteenth century but the theoretical workers were unable to explain the existence of air resistance. Their mathematical system therefore had no practical effect on the design of the first airplane.

In the nineteenth century experimenters had demonstrated the existence of air resistance and attempted to measure it. The knowledge available to the Wrights was purely empirical, obtained from falling bodies, whirling arms, and measurements in the natural wind. Their own experiments with gliders at Kitty Hawk gave results which differed greatly from what they had been led to expect by the tables of wind pressure available to them. They had to make new measurements in a wind tunnel of their own on which to base the design of their Flyer.

The period of empiricism and sterile theory extended until Prandtl in 1918 perfected the mathematical theory of wings producing lift corresponding to concepts of the nature of the flow of air independently stated by Lanchester. This theory was experimentally confirmed in Germany during the First World War. These results were not known outside Germany until 1921. In the Prandtl school at Göttingen the theoretical and experimental stream came together to establish a science of aerodynamics useful in aircraft design.

The exploration of more realistic theories has continued. When checked and guided by suitably planned experiments, these theories became the foundation for prediction and analysis of results of experiments not yet made as well as the basis for rational design procedures. Similar developments have occurred in the field of airframe engineering. Coordinated theoretical and experimental work on the deformation and stress distribution in structures has led to more effective designs. The development of power plants is still greatly dependent on empirical tests and experience, although the jet engine has provided better opportunities than the reciprocating engine for guidance of design by rational analysis.

For some twenty or twenty-five years following the introduction of the Prandtl wing theory, designers exploited a rational theory of incompressible

flow. Although Prandtl in the early twenties also proposed methods to deal with problems of compressible flow at speeds near the speed of sound, and compressibility effects were encountered in propellers, it was not until the Second World War that airplanes in dives approached the speeds where compressibility of the air produced serious control and stability difficulties. Then supersonic three-dimensional wing theory was born almost overnight, and intensive research began, leading to Yeager's historic flight at speeds faster than sound in October, 1947, in a research airplane, the Bell X-1, and later to the first supersonic tactical airplane, the North American Super Sabre, also called F-100, which first flew in 1953.

NATIONAL AERONAUTICAL RESEARCH LABORATORIES

A striking feature of the aeronautical research scene today is the existence in every large country of national laboratories for the conduct of basic and applied aeronautical research. Fifty years ago research in aerodynamics was conducted by private individuals with independent means and technical background or by professors with leisure and mathematical skill. The results of wind tunnel experiments made available by Eiffel in France and Riabouchinsky in Russia had an immediate and practical influence on the progress of aeronautics in its second decade. However, the mathematical analyses of fluid motion by Kutta, Joukowski, and Lanchester in the first decade, extending previous work of Helmholtz, Kelvin, and Rankine, built a foundation for aerodynamic theory that did not have practical effects until much later.

On May 5, 1909, the Prime Minister of Great Britain announced the appointment of an Advisory Committee for Aeronautics to superintend experimental and theoretical investigations to be conducted in a newly organized department of the National Physical Laboratory and to give general advice on scientific problems arising in connection with the work of the Admiralty and War Office in aerial construction and navigation. In their first annual report for 1909-10, this Committee interpreted its assignment as "the scientific study of the problems of flight, with a view to their practical solution" and the guidance of "research and experiment into these subjects in a properly equipped laboratory, with a trained staff."

The U. S. National Advisory Committee for Aeronautics (NACA) was established in 1915 with the same mission. The organizations dif-

ferred in that the experimental laboratories for aeronautics were operated directly by the NACA rather than appended to an existing scientific laboratory. Somewhat similar national research agencies were formed in France, Germany, Italy, and Russia.

The pattern of development of these laboratories has followed that of industrial laboratories to the extent that applied research to remove limitations to further technological progress forms a large part of their operations. Further the scale of their operations has been determined largely by the dominant role of aeronautics in military power. Thus at present the NACA operates three large research centers and two field stations with a staff of about seven thousand, a capital investment of more than two hundred million dollars, and an operating budget of about fifty million dollars per year.

From the point of view of science aeronautics draws on nearly every scientific field and requires coordinated attack using many disciplines for the solution of really difficult technical problems. In the words of the late Frank Jewett, "While genius will produce superior results in science as elsewhere, the [research] method itself is a lever which when understood can be effective in the hands of many less-than-genius caliber men." Since the research "team" is a familiar tactic of many fields of modern science, I need only say that aeronautical research was one of the first to realize the potentialities of this approach.

NEW RESEARCH TOOLS AND FACILITIES

Another prominent feature of aeronautical research through the first half-century which is shared with some other fields of science is the progressive creation of new tools and facilities, of which the wind tunnel is the best known example. The utility of a wind tunnel is based on the principle that the force on a body moving through the air is the same as that on a body held at rest in a uniform air stream of the same speed. This principle was stated by Leonardo da Vinci as "Tanto si fa con la cosa incontro all' aria immobile, quanto l'aria contro la cosa ferma." (What an object does against the motionless air, the same does the air moving against the object at rest.)

The first wind tunnel of which I have record was designed by F. H. Wenham about 1870 for the Aeronautical Society of Great Britain. It was eighteen inches square and ten feet long. The models were one foot square and we now know that

these were too large in relation to the tunnel size to give accurate data. Reference has already been made to the Wrights' wind tunnel of 1901. It was sixteen inches square and about six feet long. Models of airplane wings, one by six inches, were tested at twenty-seven miles per hour.

The wind tunnel is our most valuable research tool, and in addition wind tunnels are widely used to investigate by tests in advance of construction, whether a new airplane will prove satisfactory. With the growth in performance, size, and complexity of modern airplanes has come a growth in the performance, size, and complexity of wind tunnels. Some have test sections only a few inches across, with speeds up to six thousand miles per hour. One of the NACA's wind tunnels has a test section forty by eighty feet, with a speed of about two hundred and fifty miles per hour. It is used to study the landing and take-off characteristics of very high speed aircraft; so far as is known, it is the largest wind tunnel in the world.

The wind tunnels now most in demand both for research and for tests of the final design shape of our newest airplanes are the transonic tunnels operating at speeds near the speed of sound. At transonic speeds, the air flow is mixed, part slower than sound, part faster than sound. We still lack the mathematical means for predicting aerodynamic behavior in the transonic range; this lack can be compensated only by providing adequate information experimentally.

Wind tunnels providing transonic and supersonic test speeds require large amounts of power. The largest of the NACA's supersonic tunnels has a test section six by eight feet and an operating speed twice that of sound. It is powered by electric motors providing eighty-seven thousand horsepower.

Under construction today at NACA laboratories and at the Air Forces's Arnold Engineering Development Center are five new supersonic wind tunnels, part of the Unitary Plan authorized by the Congress just after the last war. Some of these tunnels will be powered by electric motors of more than two hundred thousand horsepower. One will reach speeds five times the speed of sound or more than three thousand miles per hour.

There are many other specialized tools of aeronautical research, such as the large altitude tanks and associated large compressors, exhausters, heaters, and coolers which permit the duplication on the ground of the conditions surrounding a jet engine at altitude and permitting the study of its

operation at full thrust. Research on engines and their components is an essential part of assuring their satisfactory operation and increasing their performance.

At the NACA Wallops Island station, on the Atlantic Coast just south of Chincoteague Island of wild pony fame, models of airplanes and missiles are propelled to supersonic speeds by means of rockets. Mechanisms within the model operate control surfaces and the resultant air forces are reported by radio signals emanating from instruments within the model. These signals continue to be broadcast as the model slows down through the entire speed range after the rocket has burned out. Such models disclose instability or other undesirable flight characteristics inherent in a particular design, thus giving information supplementing that obtained in wind tunnels.

PRESENT SPECTRUM OF RESEARCH ACTIVITY

In addition to the growth of the large national aeronautical research organizations and the progressive creation of new tools and facilities of increasing cost and complexity, the research activity itself has progressed from the unrelated investigations of a comparatively few individuals on subjects which attracted their attention to the organized effort of large groups on programs whose goals are set by the joint thinking of university scientists, research staff, aircraft designers, and aircraft users, both civil and military. It is the collaboration of scientist, designer, and user which has made aeronautical research so fruitful and permitted such a rapid rate of progress.

The adoption of research techniques by industry and the change in motivation from advance in knowledge to the needs of practical application have modified the original meaning of the word research. It now describes a whole spectrum of activities which range from the exploration of new fields of knowledge and the search for understanding to many aspects of the development of useful devices. The original scientific meaning has been lost. Research is commonly associated with development in the phrase research and development, thought of as almost one term to describe all activities leading up to a new industrial product, but the phrase is often shortened to research. Thus the public is led to believe that some two billion dollars are spent for "research" by the Federal Government, when actually the research expenditures for all purposes not immediately re-

lated to practical application in all fields, including agriculture, public health, nuclear energy, aeronautics, electronics, ordnance, etc., were 121 million dollars in the fiscal year 1952 according to studies by the National Science Foundation, or about six per cent of the gross amount reported.

BASIC RESEARCH

Attempts have been made to clear up the confusion in meaning by the use of modifying adjectives to describe various parts of the spectrum of activities but with limited success. Thus the terms pure research, fundamental research, basic research have been suggested as synonymous with the original meaning in science, namely, activities which involve exploration of natural phenomena with new instruments and experimental techniques, and the development of new concepts or improvement of older ones, all with a view to understanding the underlying phenomena. None of the adjectives is now satisfactory, for what seems basic or fundamental to one group is regarded as applied research by another.

In the aeronautical field, this type of research may be illustrated by studies directed toward the understanding of the flow very close to the surface of airplane wings in the so-called boundary layer, how it is affected by the pressure variation over the surface of the wing, by surface roughness, by the impingement of shock waves on it, by the flow of heat to or from the surface, by the flow of air to or from a porous surface. An understanding of the flow in the boundary layer is the key to understanding the general flow and its effects on aircraft. Basic scientific research is stimulated by practical development as in the current effort to understand the sources of noise from jet engines, particularly the part produced by the hot-air jet. While current developments cannot await the final results of such studies, it is clear that the developments of the future will be largely controlled by the outcome of current basic research.

APPLIED RESEARCH

As we proceed in the research spectrum toward development we come next to the systematic survey and accumulation of factual information for direct application in engineering, and the exploration of methods to extend the practical uses of such data. This is the more recent activity arising from the creation of extensive research laboratories to serve such fields as aeronautics and nu-

clear energy. This type of activity was called background research in the Steelman report, but is more commonly referred to as applied research. From the point of view of the scientist occupied in basic research it is applied research; the development engineer and designer regards the activity as basic or fundamental with respect to his own task. The production of aeronautical research results of this type is the main function of the National Advisory Committee for Aeronautics. NACA studies of generalized wing and body forms, typical structures or engine components varied in a systematic way, correlated theoretical and experimental studies in subsonic, transonic and supersonic aerodynamics and in structural design have been the foundation for aircraft development throughout the world.

It has been necessary to explore the practical uses of such research by tests of improved designs of components in wind tunnels, engine test facilities, and actual flight. Thus data on the transonic characteristics of compressor blade sections are utilized to design and construct experimental single-stage compressors with transonic tip speed, whose performance is measured. Based on these results a multistage compressor may be built for study. The collective experiences including design methods and performance data are then made available to engine designers who have the task of designing compressors as parts of a specific engine to meet the user's specifications. The scientific study of the problem is not considered complete and ready for practical application until experimental checks and tests of the applicability of the laboratory results are made. Many similar examples could be quoted from the current NACA program.

DEVELOPMENT

When the results of basic and applied research are applied to specific devices in the reduction to industrial practice, the process is described as engineering development or simply development. The earlier stages of this process involving the application of scientific knowledge to the solution of the practical problems arising in the development of a particular airplane, engine, or missile are also called applied research by many of those engaged in it. Thus applied research may be carried out either as the necessary part of a specific development, as when studies are made of the best shape of air inlet for an airplane whose general configuration has been finalized, or as an activity

independent of any specific airplane, as when the characteristics of air inlets of many types are systematically studied.

RESEARCH AND DESIGN

Research proceeds to advance knowledge by isolation of limited aspects of development problems, which are analyzed by specialists in specific fields. Design is still an art practiced by individuals or groups of individuals in a design team, who have general knowledge of many fields and the ability to synthesize information from many sources. The designer of an airplane, engine, or missile must solve all of the many problems in a single integrated prototype. Design decisions are usually compromises between many conflicting considerations, but there are some cases in which there is a direct correspondence between a research result and a specific application. Thus the present general configuration of transport airplanes stems from early NACA investigations of optimum location of engine nacelles and propellers, and the cowling of piston engines was developed largely on the basis of NACA applied research. The use of sweepback in such airplanes as the F-86 and the B-47 is the result of wind tunnel research largely carried out in Germany during the war.

THE ROLE OF INVENTION

The role of invention in aeronautical developments of today is the subject of much debate, some maintaining that research has taken the place of invention. Certainly inventors are dependent on a steady buildup of scientific knowledge for success. It is perhaps sufficient to mention the jet engine, radar, and the V-1 and V-2 missiles to show that invention still plays a great role in abruptly changing the direction of research and of development as well. The individual inventor seems to be less and less able to make solo contributions, but the design team must contain individuals who can obtain inventive solutions of the many complex design problems. Creative ability is essential in research in order that significant tasks may be selected for attack.

RESEARCH INFORMATION

Research information, the product of research and a raw material for inventors and designers, is a perishable commodity. Publications and meetings of scientific and engineering societies are the

normal methods of dissemination, and the use of research conferences, in which research workers summarize the state of knowledge for designers, is increasing. Military security restriction has been extended in general only to applied research data and to theoretical studies which have direct application. Advances in airplane design are dependent upon exposure of designers and inventors to the new knowledge and hence a proper balance must be established between the relative effects of restriction and dissemination of research results. In most cases it is sufficient to introduce a suitable time delay before publication so that our own designers may have time to apply the new data made available to them in confidential reports.

TOWARD THE FUTURE

As we end the first half-century there is no sign of any terminal point in aircraft development or in the ever-widening horizons of aeronautical research. The sonic barrier has given way in the face of vigorous assaults and there is now talk of the thermal barrier of the high temperatures developed when bodies move through the air at speeds of several times the speed of sound. Designers are confident that these new problems can be solved as a result of the expanding knowledge in many scientific fields and the demonstrated effectiveness of organized team research on the known problems.

A HALF CENTURY OF AERONAUTICAL DEVELOPMENT

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(Read November 13, 1953)

THIS is the fiftieth year since that early December morning when Wilbur and Orville Wright at Kitty Hawk, North Carolina, made their first powered flight. Their airplane was a fragile and unsteady contraption of no immediate utility. It flew for less than a minute, but it disclosed the solution of a problem which had baffled the inventors and scientists of the previous century.

The Wrights were the first in the history of man to fly. There was no one to teach them. They had to discover principles and to learn the art of controlling a flying machine by methodical and cautious experimenting with themselves aloft in kites and gliders. When Orville made the first powered flight in 1903, he already knew what to do.

In the course of learning to fly, the Wrights discovered the key to the riddle of control in the interaction, or cross coupling, between the roll or sidewise tilt of their glider and its yawing away from its course.

They had initially provided means to correct a tilt of their glider by twisting or warping the low wing so as to increase its angle to the wind and consequently its lift. However, the twist given the wing to increase its lift also increased its drag and caused the glider to turn toward the low side. This turning or yawing motion made the high wing move faster through the air and gain lift while the low wing moved slower and lost lift. The result was a combined yawing and rolling moment tending to make the glider go into a spiral dive.

The Wrights constructed their third glider at Kitty Hawk in the summer of 1902. With it they made many glides and eventually overcame this tendency to go into a spiral dive by means of wires interconnecting the wing warping with a large vertical rudder. Rudder action was applied to turn away from the low side whenever the wing was warped down. This invention was applied in the first powered airplane flights of December 1903 and was disclosed in their famous patent No.

821,393, granted May 22, 1906, three years after they had filed their application.

The Wrights' principle of control of attitude in the three dimensions of space was the key to the riddle of flight. Yet this 3-D concept was no novelty in mechanics. The Wrights' disclosure of simple means simultaneously to control roll and yaw was easily comprehended and promptly adopted by others, but their original idea of interconnecting the rudder and wing warping by wires was found to be unnecessary. Effective interconnection could better be made through the body of the pilot who was found to have a useful natural reaction to being upset. The patent experts held that this interconnection through the body was equivalent to the wire arrangement used by the Wrights.

It is still a mystery to some present-day students that this now obvious solution completely escaped Lilienthal and Langley and other experimenters. In 1903 all bicycle riders were well aware of the relation between the tilt of the bicycle and the course of the unstable vehicle. There is a cross coupling between roll and yaw somewhat like that of an airplane. The Wrights proceeded to find out by experiment how to control a glider the way a novice learns to ride a bicycle, without too much concern for the really elaborate dynamical relations involved. But the Wrights' simple solution was not easily discovered and applied. It required the brothers' persistence and their logical processes of deduction and experiment.

There must have been something fateful about this particular year for their great invention. The airplane was born at just the right time for its intensive development by an industrial society ready with the needed technology. Before the availability of gasoline, the Wrights' invention would have been nothing more than an improvement in gliders.

The airplane found the old marine propeller and the new gasoline engine ready for application. Pneumatic tires at once replaced skids. Precision



FIG. 1. Lilienthal got lateral control by shifting his weight.

tools and the manufacturing techniques of the automotive industry led to mass production. Steel and aluminum alloys eventually replaced the original wire-braced wood structure of the Wrights. Then came radio and special gyroscopic instruments to aid navigation and to extend the pilots' ability to fly long distances even in bad weather.

The airplane of the Wright brothers has been developed in fifty years into the swift useful vehicle that we know today. To accomplish this development, it was not enough to apply just the technology of the times to the Wright invention. Aeronautics stimulated specific inventions to solve new problems created by its own development. I think of Glenn Curtiss' ailerons; Bleriot's wheeled landing gear; Sperry's gyroscopes for so-called blind flying; Fairey's wing flaps and Handley Page's slotted wings, to slow down the landing speed of heavily-loaded airplanes; Albert Reed's metal propeller and Frank Caldwell's variable-pitch propeller. Charles Lawrance's light air-cooled engine, made Lindbergh's famous flight possible. But no one remembers the name of Paul Revere's horse.

But subsidiary inventions alone could not sustain the consistent and continuous development of the original airplane that we have seen. Scientific research was required to supply methods of analysis and techniques of controlled experiment; first, to give designers a fundamental understanding of the problems of flight and, secondly, to suggest means for their practical solution. To appreciate the role of science in the development of the airplane, we should recall that the new century was ready not only with the technology of the machine age, but ready also with the mature sciences of elasticity and dynamics to guide the development of the airplane's structure and form. Under the urge of aeronautics, a new science of aerodynamics was created from the somewhat sterile hydrodynamics of the nineteenth century and the empirical art of naval architecture.

While the Wrights were aided by their own crude wind tunnel experiments, they got no help from the theoretical science available in 1903. It was not until about 1912 that wind tunnel research became useful to designers. Mathematical generalization, however, did not come until the end of the First World War with Ludwig Prandtl's fruitful theory of lift and drag in terms of fluid circulation and viscous shear. Professor Prandtl of Göttingen, who died only this year, was indeed the father of the basic aerodynamic science which controlled the development of the airplane after 1919.

Before the Wrights, experimenters imitated soaring birds. Lilienthal's glider had bird-like wings and a tail (fig. 1). The Wrights were advised by Octave Chanute, a civil engineer, to employ a Warren truss to support a pair of biplane wings. The Wrights knew from their own wind tunnel experiments that monoplane wings gave more lift per unit of surface, but they adopted the biplane because more surface could be got for the same weight. This decision may have meant the difference between success and failure in view of the low power of their first engine. Here is an example of a designer using his own judgment in a compromise with conflicting requirements.

The Wrights also made a second design decision when they abandoned any attempt to provide inherent stability. The prior art at that time indicated that to fly a straight course a tail like a bird's was needed, with a vertical fin on it as on a weather vane. Furthermore, the wing tips should be inclined upward with a dihedral angle to ensure proper banking to correct a lateral skid. Inherently stable models successfully flown by Langley and others showed these features of external form.

The true inventor is notorious for his inde-



FIG. 2. First Airplane Flight, December 17, 1903; Orville Wright pilot, Wilbur Wright assisting the take-off.

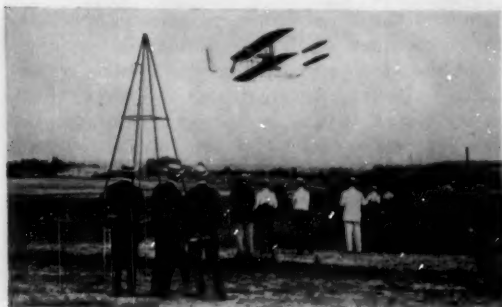


FIG. 3. First Military Flyer, Fort Myer, Virginia, July, 1909. World endurance record of one hour twenty minutes. Note pylon for falling weight to launch the plane.

pendence of the prior art, while the engineer is very respectful of it. The Wrights were primarily inventors, concentrating intensely on the problem of control. Believing that any degree of stability would render their airplane less sensitive to control, they built an intentionally unstable machine with the horizontal rudder forward (fig. 2 and 3) and with drooping wing tips. While their machine was indeed responsive to control, flying it was somewhat like a tight-rope walker's exhibition. There could be no relaxation of attention.

From our perspective of fifty years, the Wrights seem to have chosen wrong because useful development could not proceed from their original form of airplane. It was quickly superseded in the evolutionary process. However, they were certainly right for their immediate objective. They needed the light biplane structure to fly at all with their very weak engine. They also had to have an extremely quick-acting control of attitude as their under-powered airplane was always in danger of being stalled by a gust of wind.

After the Wrights' first public flights at Fort Myer in 1908, development of their airplane was taken up vigorously by others, but at the higher speeds given by better engines the Wrights' form of airplane proved to be dangerously unstable. Radical changes were made largely as a result of unhappy experience by those who followed the Wrights. Very quickly the external form of the original Wright airplane developed from an incredible looking box kite with rudders before and behind into a very acceptable bird-like form with body and tail. The old engineer's tag seemed to apply: "It's not right until it looks right."

Bleriot's lovely airplane that flew across the English Channel in 1909 looked right then and it does now (fig. 4).

The forward horizontal rudder of the Wright design was promptly moved to the rear and combined with a fixed tail surface and a vertical fin and rudder making a true tail (empennage). The skids for catapult launching were replaced by a wheeled landing gear as soon as adequate power was available for take-off. The drooping wing tips were raised to give a positive dihedral and some degree of lateral stability.

As airplanes became larger, the Wrights' Warren truss construction was found to have been compromised in rigidity by their wing-warping feature. Glenn Curtiss' hinged flaps (ailerons) took the place of wing-warping and permitted a truly rigid wing construction.

With higher speed, the exposed position of the pilot, engine, and tanks caused too much drag. The Wrights' chain-driven pair of propellers was abandoned in favor of a tractor propeller directly mounted on an engine at the front of a streamlined body (fuselage) containing the pilot, passengers and tanks, and bearing the tail surfaces at the rear. In the space of a very few years, nothing much was left of the Wright form of air-



FIG. 4. Bleriot Monoplane crosses the English Channel to Dover, July 25, 1909. Note long fuselage with tail, dihedral wings, landing wheels and tractor propeller.

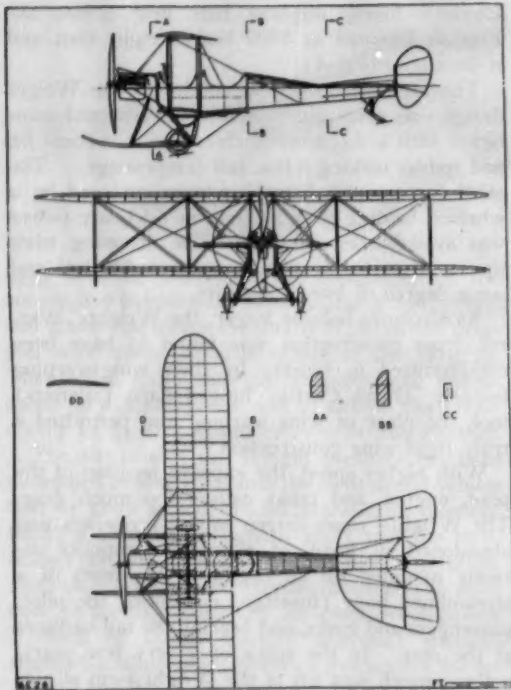


FIG. 5. British Military Biplane of 1911.
First inherently stable airplane.

plane except the biplane construction. This persisted through the First World War and into the 1920's because it was structurally efficient for the thin wings then believed to be necessary.

In the rapid development of the airplane between 1908 and 1912 the French were leaders as is indicated by the French terms quoted above (empennage, ailerons, fuselage) and now permanently incorporated into our language. The French development was initiated by individuals like Farman and Bleriot and supported by the pioneer wind tunnel research of Gustav Eiffel. This great engineer, in his retirement, was so much impressed by the need of the new art for a sound engineering foundation, that he established an aerodynamic laboratory at his own expense and freely published the results of his research.

During this same time, 1908-1912, in England, research established design rules for stability. G. H. Bryan analyzed the dynamics of flight as a classical example of the motion of a rigid body in a resisting fluid medium. Leonard Bairstow at the National Physical Laboratory wind tunnel de-

termined the aerodynamic parameters necessary for the solution of Bryan's differential equations of motion and proposed practical criteria of stability. Geoffrey de Havilland and E. T. Busk at the Royal Aircraft Factory, Farnborough, developed the famous BE2 military biplane, designed to these criteria, which proved to be both stable and controllable (fig. 5).

By 1912 aeronautical engineers, making use of research results, could design an airplane and predict its performance to a good approximation. The general form of the airplane was now established by rational requirements for the relative proportions of wing and tail surfaces, the shape and length of body, the dihedral angle of the wings, and the design of the propeller to match the characteristics of engine and airplane.

The result of such knowledge in the hands of designers practically froze the general form of the airplanes of World War I to present the following features:

(a) Biplane wings with small positive dihedral. Wing profile with rounded leading edge and gently cambered undersurface only thick enough to enclose wing beams (Handley, Page, Avro, de Havilland, Sopwith, Spad, Breguet, Albatross, Gotha, Caproni).

(b) Long fuselage carrying tail surfaces and enclosing the flight crew, tanks, and payload.

(c) Two-wheeled landing gear and tail skid or wheel.

(d) Main structure of wire-braced wood or metal members enclosed by a non-strength covering of fabric or plywood.

This general form of airplane persisted from 1912 to 1919, but at the end of the war a radically new form was disclosed in Germany. Junkers and Fokker each had in hand experimental monoplanes of curious appearance with unbraced cantilever wings (figs. 6 and 7). The Junkers wing had corrugated aluminum sheet covering an internally braced girder of aluminum tubing (fig. 8). The Fokker wing, evidently designed to a similar requirement, had deep wooden wing beams and a



FIG. 6. Junkers Low Wing Transport, 1919.



FIG. 7. Fokker High Wing Transport, 1919.

thick plywood skin. In each case the tapered wings were thick enough at the root to permit a strong cantilever construction with no external bracing.

These two airplanes were revolutionary in that the air drag of biplane struts and wires was completely eliminated, as well as the inherent aerodynamic inefficiency of the biplane. This was made possible by the fat wing profile, something entirely new to the art. The source was not far to seek.

From Prandtl's laboratory at Göttingen, wind tunnel research had evolved the so-called Göttingen series of thick tadpole-shaped wing profiles of remarkable aerodynamic efficiency (fig. 9). The necessary camber to give good lift was applied to the mean line of the profile rather than to the lower surface as had been previous practice. This research had been carried on at the University throughout the war period and became known outside Germany only after the armistice. It is



FIG. 8. Junkers Transport on floats, 1919.

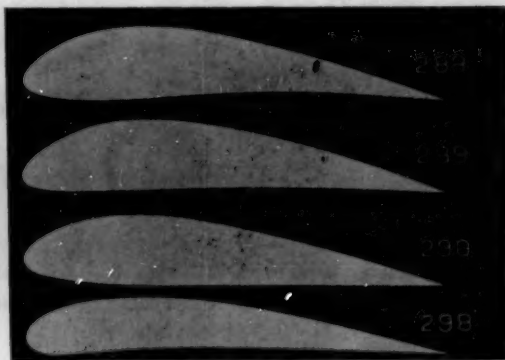


FIG. 9. Göttingen Wing Profiles suitable for tapered cantilever wings, 1918.

of interest to observe that this great German contribution to aerodynamics had not been used on German combat aircraft but had its first application to postwar civil airplanes.

While Prandtl was awarded their highest honors by British and American professional bodies and several books were written by former enemies explaining and amplifying his original concepts, there was considerable delay before German theory was fully understood and applied by designers. However, postwar advances in technology soon made such application attractive.

With the development of more powerful engines there was great incentive for designers to adopt cantilever monoplane wings in order to clean up the airplane for higher speed. The thick monoplane wings suggested retracting the landing gear into them in flight, and mounting engines on them. Higher speed suggested the application of trailing-edge flaps which, when turned down, increased the virtual camber and lift of the wings and hence reduced the landing speed.

Furthermore, spreading the weight of engines and fuel across the wings reduced the bending load on the wings and gave designers a reason to favor the use of two or four engines. At the same time that designers were attempting to mount engines on the wings, a comprehensive research program at the N.A.C.A. Laboratory at Langley Field showed that substantial savings in drag could be had by mounting the engines and their propellers well forward of the wings and by cowling them in such a way as to control the cooling air.

The effect of aerodynamic research, following the Prandtl lead, set a new trend or style culminating in the Boeing and Douglas transports of

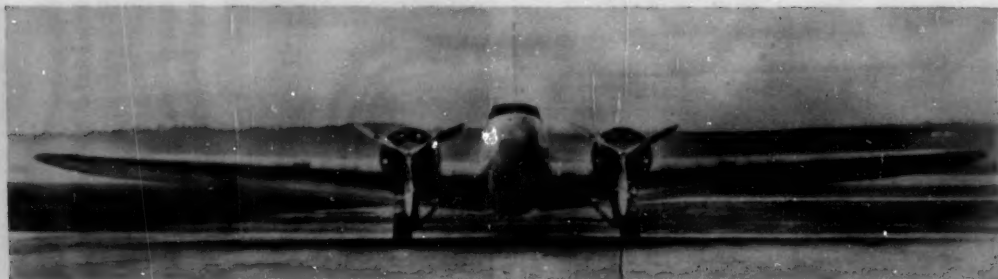


FIG. 10. Boeing Transport with retracting landing gear, 1933.

the early 1930's. These twin-engined metal monoplanes set the air transport style for the next twenty years (figs. 10 and 11).

It should be recognized that the change in the external form of the airplane from biplane to cantilever monoplane was the designer's response not only to research in aerodynamics, but also to technological advances in aeronautical power plants and in metallurgy.

The light airplane engine became much more powerful for its weight after the invention by Midgley of high-octane gasoline. Caldwell's controllable pitch propeller nearly doubled the thrust available at take-off from a given engine. These two developments, based on invention and perfected by research, gave the designer means to try for higher performance.

While Junkers' and Fokker's designs showed the type of construction necessary to realize the higher speeds made possible by better engines, the Fokker plywood and glue was unreliable and the Junkers aluminum was too heavy. The problem was solved by an advance in metallurgy. Wilm in Germany had invented a strong alloy of aluminum in 1908. This material, duralumin, was perfected for use in the framework of Zeppelin airships. The art was transferred to the United States in the 1920's for the airship building pro-

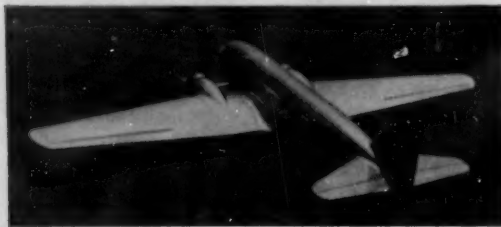


FIG. 11. Douglas Transport with N.A.C.A. cowls, 1933 style.

gram here, and duralumin then became available in useful forms to airplane designers.

In principle the Fokker wing construction was followed, with duralumin substituted for plywood. The thick wing was designed with a heavy skin of metal covering internal bulkheads, the whole acting as a single cantilever girder with stressed skin. This stressed skin construction was new for airplanes but was an old story in naval architecture. The hull of a vessel is essentially a girder in itself with the upper deck and bottom plating acting as flanges to resist bending. Every vessel has a stressed skin.

I believe it is not possible to evaluate the relative roles of design, invention, and research in aeronautical development. There is a continuous process of integration of the results of research by application to design and subsequent experimental development. Occasionally inventions or research results appear which modify the general trend of development. Throughout the history of development, there is evidence of great individual initiative by designers, involving some degree of inventive activity.

Airplane design is an art practiced by the aeronautical engineer. He strives to apply the technology of many fields to his problem, under the guidance of the concepts of scientific research and under the discipline of his own experience.

The course of development has been often affected by a few strong personalities who create styles that persist for a substantial period of time. Examples might be de Havilland's biplanes, Glenn Curtiss' flying boats, Junkers' monoplanes, Sikorsky's helicopters, Boeing's and Douglas' twin-engined transports. Whether the style set by a successful designer establishes the future trend of development or whether the style anticipates future results of research is unknowable, but it appears that a style persists only if it continues to



FIG. 12. Four Engine Transport, 1953 style.

be improved rather than made obsolete as research proceeds.

Consider the Douglas DC-3 transport of 1933. This has set the style for air transports, worldwide, for twenty years; aluminum alloy construction with tapered cantilever low monoplane wings, landing flaps, constant-speed propeller, wing-mounted air-cooled cowled engines, fuel tanks in wings, retracting landing gear, long body with central aisle for passengers. It has been called the most successful airplane design ever made. Many thousands have been built like the prototype, but incorporating successive advances in the art.

Newer transports of much greater speed and capacity have been developed and, although they may have four engines instead of two, in the air they still look like this typical American airplane (fig. 12). On the ground, one basic change is apparent. The newer style features a tricycle landing gear with a forward wheel instead of a tail wheel.

The long tapered wing has been retained because of its high structural and aerodynamic efficiency. The low wing (through the bottom of the fuselage) has proved an important safety feature in crash landings. Having the fuel all in the

wings lessens the risk of fire. To mount engines forward of the wings has been found by research to give the most efficient propeller location and the best isolation of noise and vibration. This arrangement also facilitates engine replacement and, even more important to the persistence of the style, removal of an engine from the nose permits a clear forward view for the pilot.

The Fokker and Ford tri-motor transports, with an engine in the nose of the fuselage, represented a style that was at first successful but was doomed to obsolescence because unable to utilize progress in aeronautical research.

Consider the Ford tri-motor transport as an example of great technical competence in the art of the 1920's with an almost complete failure to anticipate the trend of development. This airplane was well designed after careful study of advanced European air transport experience. The design adopted the Fokker style of a high-wing three-engined monoplane with the center engine in the nose and side engines suspended below the wings (fig. 13). Research eventually disclosed that the low propeller locations were inherently inefficient. Experience showed that the center engine subjected passengers to noise and vibration and interfered with the pilot's view ahead. In a bad landing the passengers were protected only by the soft underbelly of the fuselage. As more powerful engines became available in the 1930's, the Ford tri-motor could not readily be speeded up by their use because of the inherently high aerodynamic drag of suspended engines and the fixed landing gear. The high wing did not make it practicable to change to a retracting landing gear. Furthermore, the great advantage of the new variable-pitch propellers and landing flaps could be exploited only by a high-speed airplane of aerodynamically clean form.

With the appearance of the Douglas DC-3 in 1933, the Ford was obsolete. Here we have an



FIG. 13. Ford Trimotor Transport, 1929.



FIG. 14. Cierva Autogyro.

excellent airplane driven out of the market by a more expensive innovation. The new airplane carried more passengers faster, attracted more traffic, and enabled air lines for the first time to make a profit.

For speeds between 150 and 400 miles per hour, it seems likely that the style now considered to mark American design should persist. It has fundamental advantages. However, two outstanding current developments will require a radical change in the basic form of future aircraft. I refer to helicopters for transport speeds below 150 miles per hour and jet-propelled aircraft for speeds beyond 400 miles.

The helicopter does not derive even indirectly from the Wright brothers' airplane. Its lift does not come from the motion of fixed wings through the air but from rotating wings like propeller blades. Its control depends on means to change the direction of the lifting force of its rotor. The idea of a helicopter is very old but the use of its basic principle for human flight is comparatively recent. There were many pioneer experimenters both before and after the time of the Wright brothers. While unsuccessful, they nevertheless explored the field and added to knowledge.

The helicopter art remained in a very rudimentary state until the airplane had stimulated aerodynamic research and made available modern methods of light construction and light engines. The ground was well prepared and, as might be hoped but never exactly forecast, helicopter development suddenly flowered.

A most unexpected invention was Cierva's autogyro in Spain. Cierva applied the aerodynamic principle called auto-rotation by which a wing pivoted at the center tends to rotate like a propeller when moved through the air. He used such

an auto-rotating wing instead of a fixed wing on an aircraft that looked otherwise like an airplane (fig. 14). It had the advantage of sinking vertically to a landing. If the rotor were initially spun up to sufficient speed, such an aircraft could be made to take off very steeply from the ground and to proceed on its way with a regular airplane propeller driving it forward, while the auto-rotating wing supported it. The auto-gyro naturally created considerable astonishment, and its development was undertaken vigorously both here and in Europe. However, its practical utility proved to be elusive.

Probably stimulated by Cierva's auto-gyro, the helicopter was taken up seriously by aeronautical engineers skilled in modern aerodynamics, notably by Igor Sikorsky in this country. Sikorsky, without making any basic invention, built a series of experimental helicopters that were fully controllable in flight (fig. 15). Encouraged by Sikorsky's success, other helicopters have appeared, and there now are a fair number of successful types in current use for short haul mail and passenger service, combat rescue and supply missions, and wherever the particular performance characteristics of the helicopter are needed.

The jet-propelled airplane may be a grandchild of the Wright Flyer but it is very different both in performance and in structure. The design style has changed with the substitution of a gas turbine for a piston engine and a hot jet for a propeller.

The reciprocating airplane engine is a highly developed machine. It is mature and efforts to improve it have already reached the stage of



FIG. 15. Sikorsky Helicopter, 1944. Igor Sikorsky in rescue harness.



FIG. 16. Douglas Skyray, Naval Jet Interceptor, 754.4 m.p.h.

diminishing returns. The gas turbine is lighter and more compact and offers practically unlimited power for jet propulsion. But the designer cannot use jet propulsion effectively in an airplane designed for moderate speeds. If he estimates the fuel consumption required to drive his airplane at the presently acceptable transportation speed, he finds for jet propulsion that his fuel load is doubled and his pay-load sadly reduced. If he estimates the speed to be had from the potentially much greater power available from jet propulsion, he finds from his wind tunnel research data that his airplane should reach the velocity of sound in air, but with such outrageous fuel consumption that no payload at all is possible. Rocket propulsion is even more wasteful.

Aerodynamic research warns him that there is a physical limitation to the speed of a conventional airplane due to the compressibility of the air. Near the speed of sound, the air offers greatly increased resistance because it fails to move aside as the airplane advances. Shock or compression waves form which destroy the smooth flow over the wings, changing the aerodynamic forces. As a result, the airplane becomes unbalanced, may go out of control, or it may disintegrate under severe buffeting. A designer must conclude that con-

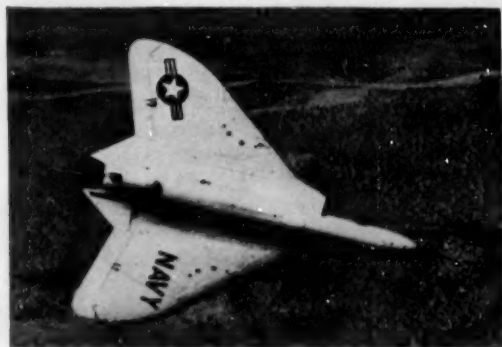


FIG. 17. Underside of Skyray.

ventional airplanes are limited for practical use to speeds well below the speed of sound. The piston engine has not enough power to push a conventional airplane through sonic speed and it could not be flown there even if enough jet power were applied.

Actually there is no absolute sonic barrier. Jet propulsion can give power enough and aerodynamic research has shown how to shape wings and bodies to be flown safely through the sonic range of speeds and into the supersonic. Here we have one answer to the relative precedence of research and development. Bold experimenters might have tried for supersonic flight as soon as jet propulsion was available, but it is unlikely that they would survive enough experiments to learn from their experience. Yet if designers waited for research to explain everything they needed to know they would still be waiting. With the guidance of research and coordinated wind tunnel and

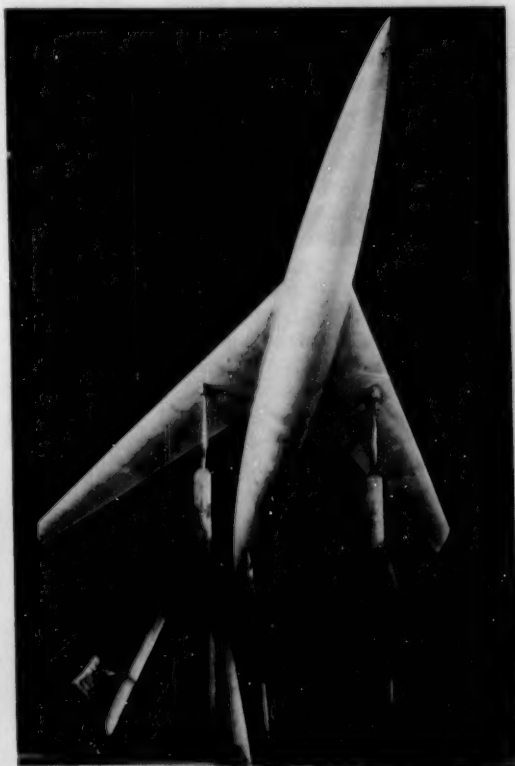


FIG. 18. Model of Supersonic Missile mounted in N.A.C.A. wind tunnel.

flight testing, supersonic flight has been achieved today.

With the advent of jet propulsion a new design style is evolving with a very slim body and swept-back wings of very thin profile, or a delta-shaped wing with no tail (figs. 16 and 17). The long narrow wings and fat bodies of conventional aircraft are unsuitable for extreme speed. One might as well consider pushing a tugboat at the speed of a destroyer. Supersonic missiles, rocket-propelled, scarcely resemble airplanes at all (fig. 18). Aerodynamic considerations require a long pointed projectile with small fins, rather than recognizable wings, for support and control.

Jet propulsion has caused a break in the steady development of the airplane. Taking speed records of propeller-driven airplanes as a measure of the progress of development since the Wright airplane of 1903, the increase has been from about 30 to nearly 500 miles per hour or at the rate of some 10 miles per year. The propeller-driven airplane has had a normal growth curve, topping off between 1945 and 1950.

Jet propulsion seems to be a mutation that upsets the trend of statistics of past growth. Its ap-

plication is still too new to establish a trend and to venture a forecast. We do know, however, that jet-propelled fighter airplanes have already been flown above the speed of sound in level flight and that a rocket-propelled research airplane was flown by N.A.C.A. pilot Crossfield on November 20, 1953 to a new speed mark of 1,327 miles per hour.

Research has shown the way to cross the so-called sonic barrier and technical development has created practical means to do so. Now that this barrier is crossed, another is in sight—a thermal barrier. At high supersonic speed the surface of an aircraft or missile can be dangerously overheated by the impact of the air. This is a new research problem requiring solution.

In aeronautical development we have had a kind of chain reaction. Research stimulated practical developments from the new knowledge disclosed. The application of the new knowledge created new problems which in turn required more research, with further new and often unexpected results. The development of the airplane and its worldwide use in peace and war has proceeded in this way on a wide front and we may expect it to continue at an even more rapid rate.

GEORGE WASHINGTON AND THE INCEPTION OF AERONAUTICS IN THE YOUNG REPUBLIC

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HIGH among the contributions of the Founding Fathers to the cultural life of the new nation was the notable part many of them had in the promotion of scientific inquiry. Popular interest in probing the laws of nature was considerable in the eighteenth century and independence proved an added incentive to experimentation. Now, more than ever, Americans were eager to match the remarkable achievements of European inventive genius. Especially was this desire for distinction in evidence in the excitement engendered by news from abroad of developments in the field of aerostation, as ballooning was at that time called. This spectacular invention had aroused intense curiosity on both sides of the Atlantic, and scientifically-minded Americans anxious to further its improvement found willing support from the country's foremost citizens. Not least among them was George Washington, who was deeply impressed by the aeronautical accomplishments of the Old World, and not only gave expression to his views in this regard, but played a prominent role in the sponsorship of the first successful balloon ascension and voyage in America. The circumstances of his identification with aeronautical beginnings in the United States, and more particularly in Philadelphia, form an interesting chapter in the annals of aerostation and throw light on the pervasive influence of national feeling and patriotic ardor in stimulating scientific endeavor.

When, in the spring of 1784, Washington was invited to attend "A Lecture on Pneumatics" by Dr. John Foulke, a young Philadelphia surgeon recently returned from abroad, Americans, even then, were not entirely unfamiliar with the aeronautical pioneering in France. The newspapers of the young republic heralded the epoch-making experiments of the Montgolfier brothers, and, relying on reports in the London and Paris press and on correspondence from Europe, kept the people posted on the latest developments. It is not surprising, therefore, that the nation's largest city should promise a receptive audience for first-

hand information about aeronautical doings in Paris.

To this task, Dr. John Foulke, newly-elected in January of that year to membership in Philadelphia's American Philosophical Society, applied himself. His previous training, European studies, and learned associations gave every indication that he could take a responsible and stimulating part in the promotion of an interest in aerostation. Nor did he fail to appreciate the historic significance of his opportunity to do so, assuming an initiative in this respect that did credit to his scientific professions. According to Francis Hopkinson, a fellow-member of the American Philosophical Society and a leading aeronautical enthusiast, Dr. Foulke was the first to make a paper "air balloon," which ascended "from the garden of the Minister of Holland" on May 10, 1784.¹ While these experiments were going forward, Dr. Foulke announced his "Lecture on Pneumatics" to be held "in the Hall of the University" of Pennsylvania on the seventeenth of that month. In keeping with the importance of the occasion, George Washington, then in the city of Philadelphia, was asked to be present.

Well might Washington have accepted the invitation and added luster to the meeting. In so doing he would have given encouragement to an inquiry near to his own expressed interest and that of other distinguished men of the day. Only the month before, he had written from Mount Vernon to General Duportail in France:²

¹ Francis Hopkinson to Thomas Jefferson, Philadelphia, May 12, 1784, Jefferson Papers, 10: 1694-1695, Library of Congress. The complete letter appears in print in George E. Hastings, Notes on the beginning of aeronautics in America, *Amer. Hist. Rev.* 25: 70, 1919. It is also in Horace M. Lippincott, Dr. John Foulke, 1780, a pioneer in aeronautics, *General Mag. and Hist. Chronicle*, 34: 529, 1932; and also in Julian P. Boyd et al., eds., *Papers of Thomas Jefferson* 7: 246, Princeton Univ. Press, 1950-1953.

² George Washington to Louis Le Bègue Duportail, April 4, 1784, in John C. Fitzpatrick, ed., *Writings of George Washington* 27: 387, Washington, D. C., 1931-

I have only newspaper Accts. of the Air Balloons, to which I do not know what credence to give; as the tales related of them are marvellous, and lead us to expect that our friends at Paris, in a little time, will come flying thro' the air, instead of ploughing the ocean to get to America.

Even as this was being penned, there was on its way to Washington a communication from Lafayette announcing plans for a visit to America that summer, and advising that "what respects balons Mr. L'Enfant will tell. . . ."³

Moreover, Dr. Foulke's reputation was such as to guarantee the fulfillment of the promises held forth in the newspaper advertisement describing the nature of the lecture. It was his intention to explain "the properties of inflammable, nitrous, fixed airs, &c.," to exhibit "a great variety of aerostatic globes," and to suggest "the uses to which Mons. de Montgolfier's ingenious discovery may be applied."⁴ Tickets of admission were one dollar each. Scion of an old Quaker family, a graduate in medicine of the University of the State of Pennsylvania, well known to Franklin, who had befriended him during his years of residence and study abroad, Dr. Foulke could be counted on to live up to the finest standards of

1944; also quoted, with slight textual variations, in Jeremiah Milbank, Jr., *The first century of flight in America*, 8, Princeton Univ. Press, 1943; and in Archibald Henderson, Washington and aeronautics—the first balloon ascension in America, *The Archive* 44: 6, Duke Univ., 1932, but Henderson does not identify the recipient of the letter nor was he careful in its transcription.

Duportail served under Washington as head of engineers during the Revolutionary War. See Elizabeth S. Kite, *Brigadier-General Louis Le Bègue Duportail, Commandant of Engineers in the Continental Army, 1777-1783*, Baltimore, The Johns Hopkins Press, 1933. On December 24, 1783, Duportail wrote to Washington from Paris about "that most extraordinary discovery ever made," the air balloon. He admitted he knew little about this "wonder of the times," and assumed particulars would be given to Washington by others, particularly the Chevalier de Chastellux. George Washington Correspondence, Library of Congress. The complete text of the letter is also available in Kite, *Duportail*, 275-277.

³ Lafayette to Washington, Paris, March 9, 1784, in Louis Gottschalk, ed., *Letters of Lafayette to Washington, 1777-1799*, 281, New York, privately printed by Helen F. Hubbard, 1944. L'Enfant reached New York from France on April 29, 1784.

⁴ This advertisement, dated "Phila., May 11, 1784," first appeared in the *Pennsylvania Journal* (Philadelphia), May 12, 1784, and then in the *Pennsylvania Packet* (Philadelphia), May 15, 1784. It is the only clue we have to the contents of the lecture.

eighteenth-century scholarship.⁵ Washington may have been informed of all this. Certainly Foulke's association with Franklin and his grandson and secretary, William Temple Franklin, while in Paris, had served to sharpen his intellectual interests, and won for him the respect then accorded Americans who had completed their education in the Old World.

Dr. Foulke had come to Paris in the summer of 1780 with a sheaf of letters of introduction to the two Franklins.⁶ The letters were uniformly high in their praise of the character and ability of the twenty-three year old physician, but, since he had not participated in the War of Independence, though a Whig, and had many Tory connections, Francis Hopkinson and Franklin's son-in-law, Richard Bache, entered a word of caution.⁷ There was no such warning, however, from Dr. Benjamin Rush, who effusively wrote Benjamin Franklin that the young Quaker "carries with him the good wishes of thousands."⁸ Dr. Foulke was soon caught up in the whirl of social activities and scientific pursuits emanating from the Franklin household. His indebtedness to Benjamin Franklin came to be considerable, and, in gratitude, Foulke paid fulsome tribute to him as "that great Parent of Mankind, Father of his Country and Protector of Science."⁹ Dr. Foulke's years

⁵ There are further details of Foulke's family background, training, and professional career in Lippincott, Dr. John Foulke, *loc. cit.*, 525-529. Though he cites the text of several important items, Lippincott's treatment of aeronautical beginnings is uncritical. For some revealing glimpses of Foulke's education abroad, see Whitfield J. Bell, Jr., Philadelphia medical students in Europe, 1750-1800, *Penna. Mag. Hist. and Biog.* 67: 3, 5-6, 8, 22, 23-24, 1943.

⁶ These are in the Franklin Papers of the American Philosophical Society and the University of Pennsylvania, and in the Bache Collection of the American Philosophical Society. There were, among others, letters from the Quaker patriot Timothy Matlack, Dr. Benjamin Rush, Richard Peters, Joseph Wharton, Jr., Francis Hopkinson, and Richard Bache.

⁷ Hopkinson to Franklin, April 22, 1780; Bache to Franklin, May 2, 1780, Bache Collection, American Philosophical Society. Dixon Wecter, Francis Hopkinson and Benjamin Franklin, *American Literature* 12: 202, 1940, makes brief mention of the friendship of Hopkinson and Dr. Foulke. There is a tribute to young Foulke's medical knowledge and surgical ability in a short sketch of his life in the J. M. Toner Collection, American Medical Biography, 6, Library of Congress.

⁸ Rush to Franklin, April 28, 1780, Bache Collection, American Philosophical Society.

⁹ Foulke to Wm. Temple Franklin, Leipsic, Oct. 1, 1781, Franklin Papers, American Philosophical Society.

abroad included some travel on the continent and a visit to London in the spring of 1783 for medical study.¹⁰ Returning to the United States, Foulke plunged into the practice of his profession with enthusiasm and confidence. On November 22, 1783, he announced in the press that "at the particular request of a number of medical gentlemen," he would give "a course of practical anatomy, dissection and preparation"; and "those gentlemen who wish to attend him, will please to call at his house in Front-Street opposite the City Vendue-Store, where they may be informed of the terras and time of commencement."¹¹ Dr. Foulke was on the threshold of a notable career in medicine.¹² But, like many a physician of his day, devotion to his specialty did not preclude a lively curiosity about science in general. Though he had complained of illness abroad, he found the energy to serve the public well and to play the part of an eighteenth-century savant.

It is not unlikely that Washington was eager to hear the lecture that Foulke had prepared. Given the background of the speaker, its scholarly sponsorship, and the convenience of the time, a Monday afternoon at four o'clock, the lecture would be an attractive respite from the proceedings of the Society of the Cincinnati over which Washington was then presiding and which had been the occasion of his visit to Philadelphia. It promised, too, to answer, in a way no newspaper account could, the many serious questions as to the possibilities and limitations of ballooning.¹³ This would be an event indeed for all those whose imaginations had been stirred by the new art of aerostation. But, at what must have been, in that less-hurried

age, "the last minute," Washington sent his regrets:¹⁴

Genl. Washington presents his Compliments to Doctr. Foulke—thanks him for his polite Card & Ticket—and would with great pleasure attend his Lecture on Pneumatics, but the business which brought him to this City does not leave him at liberty, as the Members of the Cincinnati are anxious to bring it to a close.—

Monday Morning.

That Washington was sorely pressed for time that Monday, there is little doubt. He was just successfully bringing to an end the deliberations of the first "General Meeting" of the Cincinnati, at which he had played a leading and constructive role in winning agreement to "an altered and amended" constitution, designed to meet the avalanche of objections to the Society thundered from every side since its organization the year before.¹⁵ Preparations were under way to publicize the results of the proceedings, so as to mollify popular opinion, and to send out to the state societies and the French branch a circular letter relative to the modifications in the "Institution."¹⁶ On the day of Dr. Foulke's lecture, the circular letter and the revised Institution were released to the public.¹⁷

¹⁴ Washington's note of declination and an accompanying ticket of admission have been framed and are now in the Harry F. Guggenheim Collection, the Institute of the Aeronautical Sciences, New York. The letter, with minor textual variations in spelling and capitalization, along with the ticket of admission, also appears in Lippincott, Dr. John Foulke, *loc. cit.*, 528, but he gives no indication as to the location of these items at the time he wrote his article, 1932, nor does he attempt to fix the date of the note. Though undated, the contents of the note and the circumstances of the Cincinnati proceedings point to its having been written the morning of the lecture. The note could hardly have been penned the previous Monday morning, as that was a day before the plans for the lecture were launched. Cf. *Pennsylvania Journal*, May 12, 1784. The Guggenheim Collection was received by the Institute of the Aeronautical Sciences in 1940.

¹⁵ For a concise account of the public reaction to the aristocratic tendencies of the Cincinnati, see Merrill Jensen, *The new nation*, 262-264, New York, Alfred A. Knopf, 1950. See also, for the state of opinion in Paris, Lafayette to Washington, Paris, March 9, 1784, in Gottschalk, ed., *Letters of Lafayette to Washington*, 282. Lafayette reported that "most of the Americans here are indecently violent against our Association," and sought Washington's opinion as to the merits of the criticism of the hereditary principle.

¹⁶ *Proceedings of the General Society of the Cincinnati, 1784-1930* 1: 5, 13, 16-19, Philadelphia, 1887-1930.

¹⁷ See advertisement, "Just Published and to be Sold at the Coffee House," dated "May 17," *Pennsylvania Packet*, May 18, 1784.

¹⁰ Foulke to Wm. Temple Franklin, London, April 12, 1783, Franklin Papers, American Philosophical Society.

¹¹ *Pennsylvania Packet*, Nov. 22 and 25, 1783. The advertisement was dated, "Nov. 22."

¹² Interesting facts about Foulke's medical activities are in Lippincott, Dr. John Foulke, *loc. cit.*, and in Toner, American Medical Biography, Library of Congress. See also, George E. Hastings, *The life and works of Francis Hopkinson*, 425-426, Chicago, Univ. of Chicago Press, 1926, and Francis Hopkinson, *Miscellaneous essays . . .* 3: 195-204, Philadelphia, 1792, for the feud in 1788-1789 between Dr. Foulke and Dr. William Shippen, two rival Philadelphia specialists in anatomical instruction.

¹³ Even as the lecture was being publicized, the press sought to satisfy its readers' eagerness for further particulars about aerial navigation. See, for example, the two-column account in the *Pennsylvania Packet*, May 13, 1784, of the amazing aerial voyage at Paris of Charles and Robert on December 1, 1783, the first in a hydrogen-inflated balloon.

The next day, a little over two weeks after the deliberations had begun, the meeting finally adjourned, confident that "present or future political evils" will not be connected with the Society.¹⁸

While the nature of Washington's activities prevented his attendance at the Foulke lecture, it did not end, by any means, his definite interest in aeronautical matters. It is apparent, for example, that ballooning was still very much on his mind when, in writing from Annapolis, on December 23, 1784, to the Marquis de Lafayette, he remarked: "I as little expected to cross the Potomac again this winter, or even to be fifteen miles from home before the first of April, as I did to make you a visit in an air Balloon in France."¹⁹ Washington had come to Annapolis with General Gates to represent the Virginia Assembly in discussions with the Maryland legislature "respecting the extension of the inland navigation" of the Potomac River, negotiations that were to prove momentous for the future of the nation.²⁰

The next year, in a letter from Mount Vernon to Sir Edward Newenham, Washington, while expressing his concern for the willingness of that gentleman to risk an aerial voyage, nevertheless felt that encouragement was due those young men "of science and spirit" who wished "to explore the upper regions."²¹

... the observation there made may serve to ascertain the utility of the first discovery, and how far it may be applied to valuable purposes. To such alone I think these voyages ought at present to be consigned, and to them handsome public encouragements should be offered for the risk they run in ascertaining its usefulness, or the inutility of the pursuit.

Little did Washington realize at the time that seven years later the chance to offer such encouragement would come his way, and that, as the President of the United States, he would be singled out to play a sizable part in the ceremonies incident to the first successful aerial flight in the country.

¹⁸ *Pennsylvania Journal*, May 29, 1784.

¹⁹ Washington to Lafayette, Dec. 23, 1784, in Fitzpatrick, ed., *Writings of George Washington* 28: 17.

²⁰ *Ibid.*; also cf. Edward Channing, *History of the United States* 3: 470-472, New York, Macmillan, 1905-1925; and R. G. Adams, Horatio Gates, *Dictionary of American Biography* 7: 187, New York, Scribners, 1928-1944.

²¹ Washington to Sir Edward Newenham, Nov. 25, 1785, in Fitzpatrick, ed., *Writings of George Washington* 28: 323-324.

As for Dr. Foulke, though he turned to other subjects after his initial enthusiasm, his experiments and lecture proved a stimulating prelude to several ambitious aerostatic undertakings that spring and summer of 1784. On June 11, at a meeting of the American Philosophical Society, it was moved by Dr. John Morgan that the members support "an effort to send up a large air balloon." No action was taken then, and at the next meeting, June 19, the motion was withdrawn, though Dr. Morgan did present a paper on balloons.²² But, if no formal action was taken by the Society, the members individually were extremely active at this time in promoting a project for launching "A Large, Elegant Air Balloon."²³ Whether Foulke was among them, the records do not reveal, but Francis Hopkinson, Dr. Rush, Dr. Morgan, and other eminent Philadelphians were prominent in the effort.

Even before this elaborate scheme was launched, Peter A. Carnes, a well-to-do Maryland landowner and lawyer, inspired by the success of the Montgolfier brothers with a hot-air balloon, constructed one himself, and, on June 12, from Bladensburg, announced that his "American Aerostatic Balloon" would "be exhibited in a field near Philadelphia, on the 4th of July next, if fair, if not, the next fair day."²⁴ This aerostat was destined to make aeronautical history at Bladensburg, where it was originally experimented with that June, and at Baltimore, where on June 24 it actually carried a young boy of thirteen, Edward Warren, aloft.²⁵ In advertising the Baltimore exhibition, Carnes declared that his balloon, which was nearly thirty-five feet in diameter and about thirty feet high, could carry two persons, and that

²² Early Proceedings of the American Philosophical Society . . . 1744-1838, *Proc. Amer. Philos. Soc.* 22 (3): 126, 1885; also cited, though in a different connection, by Milbank, *First century of flight*, 21.

²³ See, for example, "A. B. C." in *Pennsylvania Packet*, June 19, 1784; also *Pennsylvania Packet*, June 29, 1784. "A. B. C." is identified by Hastings, *Francis Hopkinson*, 479, as probably Francis Hopkinson.

²⁴ *Pennsylvania Packet*, June 17, 1784.

²⁵ For the Bladensburg, Md., experiments, see *Maryland Journal and Baltimore Advertiser*, June 22, 1784, and *Virginia Journal* (Alexandria), June 24, 1784. For the Baltimore ascent, see scrapbook, A-F (American), Institute of the Aeronautical Sciences, New York; *Maryland Journal and Baltimore Advertiser*, June 25, 1784; *Pennsylvania Packet*, June 29, 1784. See also Milbank, *First century of flight*, 22; and cf. review by H. L. Smith, in *Amer. Hist. Rev.* 49: 159, 1943.

it was his purpose "to ascend above the clouds."²⁰ "Made of Silk of various Colours, with a cylindrical Stove of Iron suspended at the Bottom, by which the internal Air is rarified," as an enthusiast described it, the aerostat seemed sturdy enough to tempt the adventurous, especially so since it was held captive, and could be brought down at will.²⁷ With a confidence born of his Bladensburg and Baltimore experiences, Carnes came to Philadelphia, where, finally, on July 17, he personally attempted an ascension, with disastrous, if spectacular, results.

Heralded in advance by a constant barrage of press notices, "The American Aerostatic Balloon," with Carnes aboard, rose from the "New Work House" yard the evening of the seventeenth, but some ten to twenty feet up Carnes was thrown clear as the machine hit the prison wall. Thereafter, the aerostat ascended to an astonishing height, then, some minutes later, burst into flames, "was entirely consumed, and the furnace, iron work, &c. in the space of about five minutes more, fell to the earth."²⁸ Despite this misadventure, there was no diminution of public interest in the future of ballooning, nor any attempt to minimize Carnes' "noble, great and laudable" intentions.²⁹ Whatever his hopes, the result had been failure, giving a renewed stimulus to those who had been

seeking subscriptions originally for "a large elegant Air Balloon, capable of raising great weights, and of carrying up men and . . . animals into the atmosphere." It was felt that Carnes' balloon was "of too flimsy a texture" for this purpose, and that public support was insufficient "to make it stronger." Another approach was needed:³⁰

The undertakers of the Subscription-Balloon, which now, once more, bespeaks the contenance and support of the lovers of philosophy, and the curious investigators of nature, have no doubt but they shall have it in their power to guard against those defects and accidents, to which a private undertaking so great and important must be liable. As they intend to construct their aerostatic machine on a scale befitting the metropolis of one of the first states in the union, . . . they can entertain no apprehensions that they shall not meet with the . . . support of the officers of government, who, as first in dignity and trust, ought to be foremost in improving every discovery which has a tendency to reflect credit upon the people over whom they preside. . . .

The citizenry, too, was asked to join with government officials "to advance the interest of science," so as not to let the nations of Europe outshine America. Plans called for a balloon of sixty feet diameter, made of fine, strong linen, and strengthened with the addition of a net-work covering.

Though it had been emphasized in the very first announcement of plans for the Subscription-Balloon on June 19 that its sole aim was the advancement of knowledge by "the enlightened and patriotic sons and daughters of American freedom and science," an endeavor that "will tend to exalt our national character for philosophy and love of science," the general response was not as great as expectations warranted. An original plan had been to use hydrogen, then referred to as "inflammable air," to inflate the large balloon, or, at least, a small experimental aerostat, but after Carnes' debacle, the sponsors apparently decided on a hot-air machine.³¹ In the end, the whole

²⁰ *Maryland Journal and Baltimore Advertiser*, June 15, 1784.

²⁷ *Ibid.*, June 22, 1784. At Bladensburg, "several Gentlemen expressed a Desire" to ascend.

²⁸ From an excellent eye-witness account, dated "Philadelphia, July 24," in the *Pennsylvania Packet*, July 27, 1784. Other accounts are in the *Pennsylvania Packet*, July 20, 1784; *Pennsylvania Gazette* (Philadelphia), July 21, 1784 (same article as in the *Packet* for July 20). See also Joseph Jackson, ed., *Encyclopedia of Philadelphia* 1: 217, Harrisburg, National Historical Association, 1931-1933; N. H. Randers-Pehrson, First flight in U. S. started here, *Public Ledger* (Philadelphia), July 3, 1932; and scrapbook, A-F (American), Institute of the Aeronautical Sciences, containing clippings from the *Maryland Gazette* (Annapolis), July 29, 1784, *Virginia Journal* (Alexandria), July 29, 1784, and the *Connecticut Journal* (New Haven), July 28, 1784. For preliminary press notices, see especially, *Pennsylvania Packet*, July 17, 1784; and *The Boston Magazine* 1: 400, July, 1784. For another first-hand report, just printed, see Dr. Benjamin Rush to Mary or Susan Stockton, Philadelphia, July 30, 1784, in L. H. Butterfield, ed., Further letters from Benjamin Rush, *Penna. Mag. Hist. and Biog.* 78: 22-25, 1954.

²⁹ *Pennsylvania Packet*, July 27, 1784. The *Freeman's Journal* (Philadelphia), July 21, 1784, in an account of Carnes' ascent, dilated on the potentialities of aerostation, and wondered "to what amazing perfection these globes may be brought. . . ."

³⁰ "A. B. C." in *Pennsylvania Gazette*, July 28, 1784. Lippincott, Dr. John Foulke, *loc. cit.*, 530-531, though relying on an accurate account in J. T. Scharf and T. Westcott, *History of Philadelphia, 1609-1884*, 1: 436-437, Phila., L. H. Everts & Co., 1884, does not distinguish clearly between Carnes' "American Aerostatic Balloon" and the movement for a Subscription-Balloon, or, as it was referred to in the newspaper advertisements, "A Large, Elegant Air Balloon."

³¹ Cf. *Pennsylvania Packet*, June 29, 1784, or *Pennsylvania Gazette*, June 30, 1784, and "A. B. C." in *Pennsylvania Gazette*, July 28, 1784. The announcement of "A. B. C." in the *Pennsylvania Gazette*, July 28, 1784,

idea seems to have been abandoned, as there is no further mention of the Subscription-Balloon in the newspapers. It is likely that subscriptions came in too slowly and fell "far short of the estimate of expences." Obviously the launching of such a project called for a degree of entrepreneurial talent not readily available. Members of the American Philosophical Society, from whose ranks such leadership could have come, were occupied with other pursuits.⁸² In the next half-dozen years the minutes of that Society touch on the subject but once, and then in connection with advice being asked concerning balloons of metal.⁸³ It remained for a visitor from abroad to give a practical demonstration of the wonders of flight.

Jean-Pierre Blanchard, Europe's famed aeronaut, arrived in Philadelphia early in December 1792, and proceeded forthwith to enlist the help

also appeared on the same day in the *Freeman's Journal*, and in the *Pennsylvania Packet*, July 29, 1784, and the *Independent Chronicle* (Philadelphia), July 31, 1784.

⁸² Dr. Foulke, for example, was very active in the Society's affairs, but seems not to have delved any further into aerostatics, devoting his time to medical matters. Early Proceedings, *Proc. Amer. Philos. Soc.* 22 (3): 136, 147, 149, 152, 154, 158, 165, 169, 1885. In January, 1789, in a letter to the president, Benjamin Franklin, Foulke, "for want of leisure," resigned as one of the Society's secretaries, a post he had held since 1786. Letter of resignation in American Philosophical Society Archives. However, Dr. Foulke continued to play a part in the Society's proceedings. *Ibid.*, 170, 194, 209; Foulke to the President of the Society, Oct. 18, 1792, American Philosophical Society Archives. Dr. Foulke died in 1796.

⁸³ *Ibid.*, 164 (Oct. 17, 1788). Over in New York City, on September 23, 1789, Joseph Deeker, who had had some aeronautical experience in Bristol, England, in the spring of 1785, sought, after several months of publicity, to ascend in a "Large Balloon," of "upwards of one hundred feet in circumference," at "a lot near the race track," bounded by Eagle, Suffolk, and Cellar Streets; but the aerostat was destroyed by fire "by some accident . . . arising from pressure of the mob." While there is no evidence that Washington took any unusual interest in this undertaking, the press reported "two-thirds of the city" out for the occasion; as one paper remarked, "the influenzo was universal." Moreover, Mrs. Washington visited Deeker's "Exhibition Room," at 14 William Street, in July to see his "Speaking Image" and other displays. *Annual Register* 27: 230, 323, London, 1784-1785; *Daily Advertiser* (New York), June 11, 1789, *et seq.*; *New-York Jour. and Weekly Register*, September 24, 1789; *New-York Packet*, September 12 and 24, 1789; T. E. V. Smith, *The City of New York in the year of Washington's inauguration, 1789*, 184-185, New York, 1889; Stephen Decatur, Jr., *Private affairs of George Washington from the records and accounts of Tobias Lear, 1789-1792*, 38, Boston, Houghton Mifflin, 1933.

of the great and near-great, the learned and the curious, the rich and the poor in plans for an aerial ascension. His previous triumphs guaranteed almost certain success, and he left no trick of showmanship unturned to stir up public excitement.⁸⁴ Quick to sense the high drama of the role he was playing in the capital of the young nation, Blanchard sought the patronage of the President himself, the governor of the state, the French minister, and other notables. According to available records, they did not begrudge him this honor. There is a question, however, about Washington's actual presence in the yard of the Walnut Street prison on the morning of January 9, 1793, when Blanchard began his celebrated flight. Back in the 1920's Randolph G. Adams saw a letter in a dealer's shop to the effect that Washington regretted he could not attend, "that a meeting of the Order of the Cincinnati, or some . . . committee, has forced him to decline the pleasure. . . ." ⁸⁵ But the weight of evidence is against this suggestion that the President did not come in person, and it would seem that this description fits the contents of the letter of 1784 to Dr. John Foulke, as, despite search, no other letter has come to light. Moreover, the fragment of information about the Cincinnati must be eliminated, as that Society held its "Fourth Triennial General Meeting" in Philadelphia on May 6 and 7, 1793, and not in January. In fact, though Washington was elected president-general at the meeting, the proceedings do not even list him as being present.⁸⁶

⁸⁴ For Blanchard's European career, see Sidney I. Pomerantz, Jean-Pierre Blanchard's early exploits in aeronautics, *Aeronautica* 3: 6-8, New York, Institute of the Aeronautical Sciences, 1951. On Blanchard's publicity methods, see *ibid.* and Henderson, Washington and aeronautics—the first balloon ascension, *loc. cit.*, 6. With the exception of the reference to Washington's letter to General Duportail, *supra*, note 2, Henderson's article, as its title indicates, deals almost exclusively with some of the dramatic highlights of Blanchard's flight of January 9, 1793, and serves as a vehicle for the publication, for the first time, of a letter describing the ascension, and written by Henderson's great-great-grandfather, General John Steele, comptroller of the United States Treasury, who was an eye-witness of the event.

⁸⁵ Colton Storm and Howard Peckham, in Selling rare books, *Publishers' Weekly* 150: 2909, Nov. 23, 1946; also *idem.*, *Invitation to book collecting*, 204, New York, R. R. Bowker, 1947. In correspondence with me on Feb. 14 and 19, 1948, Mr. Storm confirmed this account of the Washington letter and its probable contents as remembered by Randolph G. Adams.

⁸⁶ *Proceedings, Society of the Cincinnati* 1: 53-54, 1887-1930. The annual meeting of the Pennsylvania State

It is unfortunate that there is no clue to the events of January 9 in Washington's own writings, though Fitzpatrick does reprint the "passport" given to Blanchard that day by the President.³⁷ However, on the positive side, account must be taken of Washington's lively interest in ballooning, nor must we discount Blanchard's warm tribute to the President for "the gracious reception" with which he "was welcomed by the hero of liberty, General George Washington."³⁸ Of course, Blanchard's *Journal* of his forty-fifth ascension, for such it was, contains a convincing description of Washington's participation in the prison yard preliminaries:³⁹

I hastened to take leave of the President, and of Mr. Ternan, Minister Plenipotentiary of France to the United States. I then received from the President the most flattering mark of his good will in the passport which he was pleased to deliver me with his own hand. . . .

The moment of my departure was announced by the last discharge of the artillery; I then ascended my car. . . .

The newspaper stories are equally specific as to his presence.⁴⁰ One of the best of these, an eyewitness report, was published the very day of the ascent:⁴¹

Society of the Cincinnati was held on July 4 of that year. *Pennsylvania Gazette*, July 3, 1793; *Dunlap's American Daily Advertiser* (Philadelphia), July 4 and 5, 1793.

³⁷ Fitzpatrick, ed., *Writings of Washington*, 32: 296-297.

³⁸ Jean-Pierre Blanchard, *Journal of my forty-fifth ascension*, 9, Philadelphia, Charles Cist, 1793. A type facsimile reprint of this *Journal* is available in Carroll Frey, *The first air voyage in America*, Philadelphia, Penn Mutual Insurance Co., 1943.

³⁹ Blanchard, *Journal*, 13-14. The French minister was John de Ternant; Blanchard's *Journal* reference to him lacks the final "t" in the spelling of his name.

⁴⁰ See, for example, *The Mail*; or *Claypole's Daily Advertiser* (Philadelphia), Jan. 10, 1793; *Pennsylvania Gazette*, Jan. 16, 1793; *The Federal Gazette and Philadelphia Daily Advertiser*, Jan. 9, 1793.

⁴¹ *The Federal Gazette and Philadelphia Daily Advertiser*, Jan. 9, 1793. This account was reprinted in *The Mail*; or *Claypole's Daily Advertiser*, Jan. 10, 1793. Lewis Leary, in a careful recent article, Phaeton in Philadelphia: Jean-Pierre Blanchard and the first balloon ascension in America, *Pennsylvania Mag. Hist. and Biog.* 67: 54-55, 1943, raises no question as to the authenticity of Washington's presence at the scene of the ascension. Regrettably, neither the Steele letter, appearing in Henderson, Washington and aeronautics—the first balloon ascension, *loc. cit.*, 9-10, 11, nor an equally important first-hand account, written by Dr. Benjamin Rush, makes any mention of Washington's presence at the scene of the ascent. See Benjamin Rush to Elizabeth Graeme

At last, every thing being ready, M. Blanchard respectfully took his leave of the President, who gave him a folded paper, which we suppose to be a recommendation to the inhabitants of whatever place he may light upon. After he had taken his leave, the president called him back and said something to him that we did not hear. Then the aeronaut having bowed to the spectators, ascended his boat, which was painted blue and spangled with stars on the outside, and holding in his hand a flag, with the colours of the United States, he threw out part of his ballast, and precisely at 5 minutes past 10 o'clock, the balloon rose slowly and perpendicularly to soft music, amidst the shouts & bursts of applause of all the spectators. The President took off his hat, and bowed to him as he ascended.

Blanchard's flight lasted forty-six minutes and carried him some fifteen miles to a clearing near Woodbury, New Jersey, where he descended. Returning by horse, carriage, and boat to Philadelphia that evening, he hastened to pay his respects to Washington. "I had the honor," wrote Blanchard in his *Journal*, "to offer him my colours, which he politely accepted, and thereby acquired a fresh claim to my gratitude."⁴² Later that year the Philadelphia printer, Charles Cist, brought out Blanchard's *Journal* of the ascension, dedicated, appropriately enough, "To George Washington, President of the United States of America, the Patron of Liberty, the Laws, and the Fine Arts."

Not only Washington but Thomas Jefferson came within the orbit of Blanchard's attentions. The Secretary of State, duly impressed by Blanchard's daring and skill, seems to have shown the aeronaut some friendliness.⁴³ It was enough,

Ferguson, Philadelphia, January 18, 1793, in L. H. Butterfield, ed., *Letters of Benjamin Rush*, *Mem. Amer. Philos. Soc.* 30 (2): 627-628, Phila., 1951; see also G. W. Corner, ed., *Autobiography of Benjamin Rush*, *Mem. Amer. Philos. Soc.* 25: 304, Phila., 1948. Henderson, *loc. cit.*, 9, is in error in saying that Jefferson does not mention the flight. See *infra*, note 43.

⁴² Blanchard, *Journal*, 26-27; also *cf.* *Pennsylvania Gazette*, Jan. 16, 1793; and an article signed "J. H." in *The Federal Gazette and Philadelphia Daily Advertiser*, Jan. 19, 1793.

⁴³ In the Jefferson Papers, Library of Congress, there are MS. copies of two communications to Jean-Pierre Blanchard, dated Dec. 30, 1792, and Jan. 8, 1793 (Notes on Naval Balloons). These, apparently induced by Blanchard's notice of an ascension, were sent at the time to Jefferson, it would seem, by Blanchard, although there is no covering letter. For Jefferson's reaction to Blanchard's ascent, see the letters to his daughter Martha (Mrs. Randolph), from Philadelphia, Dec. 31, 1792, and Jan. 14, 1793, in the Thomas Jefferson Papers, Massachusetts Historical Society.

at least, to prompt the financially embarrassed Frenchman to press Jefferson to intercede with the President to extend a loan of \$400. Writing to Jefferson in October of that eventful year, in the midst of the devastating yellow fever epidemic that had infested Philadelphia, Blanchard bewailed the series of misfortunes that had been his since the great ascension. The public subscriptions had been so poor for the first and subsequent exhibitions that he had been forced into debt. As a stranger in the land, he had no one to turn to, and so he appealed to Jefferson, because "you alone in this country, can appreciate artists and their troubles." Outlining some of his plans to recoup his losses, Blanchard hoped to pay back the loan "before next Spring," anticipating a much better reception "in the other cities on the continent."⁴⁴ Some weeks later, having received no reply, Blanchard wrote again, expressing fear that the letter had gone astray, "since the greatest personages of Europe have never neglected" answering me.⁴⁵

Jefferson replied quickly enough this time, explaining that the letter of October 16 had been delayed in reaching him, as he had been in Virginia. Concerning "the application to the President which you desire me to make," it "is entirely foreign to my official relations with him." In conclusion, Jefferson wrote with sincere regret:⁴⁶

I wish that my own resources were such as that I might from them have accommodated you with the sum you desire, but I am about to leave this place within

⁴⁴ Jean-Pierre Blanchard to Thomas Jefferson, Oct. 16, 1793, Jefferson Papers, Library of Congress. By mid-November, the yellow fever epidemic was completely spent. See Dr. John Foulke, *et al.*, to James Vanuxem, Philadelphia, Nov. 16, 1793, reporting on the inspection of a "french armed ship" in the harbor. In Manuscripts Collection, Pennsylvania Historical Society.

⁴⁵ Blanchard to Jefferson, Dec. 14, 1793, Thomas Jefferson Papers, Massachusetts Historical Society.

⁴⁶ Jefferson to Blanchard, Philadelphia, Dec. 15, 1793, Jefferson Papers, Library of Congress.

a few days, and on summing up my affairs I find my engagements so much more than I had expected as to place me under real difficulty to provide for them.

Despite this unhappy dénouement, Blanchard continued to carry on, finding in other American cities men still willing to lend him material encouragement. But he never succeeded in making another aerial voyage in the United States.

Almost a decade had elapsed since Dr. John Foulke had formally brought the aerostatical knowledge of the Old World to the attention of the New. About that time, Benjamin Franklin, writing from Passy to Sir Joseph Banks, President of the Royal Society in London, had predicted that the art of flying "may be attended with important Consequences that no one can foresee."⁴⁷ And so it proved to be in many ways, though not precisely in the form envisioned by the eighteenth-century enthusiasts of the science. For the men of that day, aerostation was "one of the grandest, most beautiful and most useful discoveries this age has produced."⁴⁸ In this sentiment, from the fullness of their own knowledge, Washington and Jefferson would have concurred, Blanchard's trials and tribulations notwithstanding.

⁴⁷ Franklin to Banks, Nov. 21 (?), 1783, in A. L. Rotch, Benjamin Franklin and the first balloons, *Amer. Antiquarian Soc. Proc.*, N. S., 18: 265-269, April, 1907. Actually, as Rotch shows, *loc. cit.*, 273, the date of this letter is Nov. 22. Besides this, Rotch reproduces four other letters from Franklin to Banks, dated Aug. 30, Oct. 8, Nov. 30, and Dec. 1, 1783. These letters follow Franklin's press copies and are free of the errors of those in the Smyth and Bigelow editions of Franklin's writings. The Nov. 30 letter appears for the first time in Rotch. See Rotch, *loc. cit.*, notes, pp. 259-260, 273-274.

For a critical estimate of Franklin's appreciation of the implications of aerostation, see I. Bernard Cohen, Benjamin Franklin and aeronautics, *Jour. Franklin Inst.* 232: 101-128, 1941. Cohen does not use the Rotch collection, relying on the Smyth edition for his version of the Nov. 21 letter and other Franklin-Banks correspondence.

⁴⁸ "A. B. C." in *Pennsylvania Gazette*, July 28, 1784.

SPENCER FULLERTON BAIRD AND THE PURCHASE OF ALASKA¹

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ALASKA, although it contained over 375,000,000 acres, was called "Seward's Folly" in 1867, when it was purchased from Russia for \$7,200,000. William H. Seward had visions, as Senator, of acquiring Alaska and other portions of the American continent for the United States as early as 1860.² Very few men at that time had facts or the imagination to influence legislation in that direction. The war between the states also helped to prevent any negotiations from being completed at that time. However, one scientist, Spencer F. Baird, then Assistant Secretary of the Smithsonian Institution, was collecting trustworthy information on the natural history and potential resources of Alaska. But his wildest dreams never fancied that in a single year, the value of canned fish alone, might amount to \$56,200,000³ or about eight times its purchase price. For the year 1938 it might be mentioned that the output of gold was approximately \$18,500,000.⁴ It also supplies all domestically mined tin and turns out copper, platinum, coal, oil, gypsum, limestone, and marble. Since its purchase, Alaska has returned over \$3,200,000,000 worth of products to the United States.⁵ The main function of this paper is to show how Baird, a foremost scientist of his time, was helpful in inducing Senators to ratify the treaty and Representatives to pass the appropriation bill for the purchase of Alaska.

Very little information of a confirmed nature has been found concerning the negotiations for its purchase but it is known that Seward, a member of Johnson's cabinet was its principal mediator. Seward writes in one of the few papers on the subject; "Probably this treaty stands alone in the history of diplomacy, as an important treaty, con-

ceived, initiated, prosecuted and completed without being preceded or attended by protocols and despatches."⁶

It is known, however, that late in 1866 the Russians wished that the idea for its purchase would originate with someone connected with the U. S. Government. About that time the California Fur Company hoped to organize a trading company between the United States and the Russian possessions in North America and the Legislative Assembly of Washington Territory wished to obtain rights and privileges for their fishing vessels to visit the ports of Russian America. On March 8, 1867, Baron de Stoekl, the Russian Minister, returned to his post in Washington. While paying his call at the State Department he remarked about the inability to grant a franchise requested by the California Fur Company. Seward then said the citizens of Washington Territory wished to fish in Russian waters. Stoekl replied that Russia would not grant this request. Seward followed with the suggestion that Russia might sell Alaska. This was the opening which Stoekl wanted and in reply stated that, if an offer were made now, Russia would consider it. After a few weeks of conferences with the President and other members of the cabinet, Seward concluded the treaty of cession on March 30, 1867, with Stoekl.

On that date, Charles Sumner, Senator from Massachusetts, Chairman of the Committee on Foreign Relations, was called to the home of Seward to be informed that a treaty was about to be signed with Russia concerning the cession of Alaska. He was not consulted beforehand about its purchase nor had any of his congressional colleagues been informed about the matter until the Senate was convened in executive session by the proclamation of the unpopular President. No ratification occurred at this session because the Senators were irritated by the method which the President, and his cabinet, but more particularly Seward, had devised to have it ratified before effective opposition would develop. In this

¹ Research was carried out with the aid of a grant from the Penrose Fund of the American Philosophical Society.

² Bancroft, F., *The life of William H. Seward, II*, 471, New York, Harper, 1900.

³ Colby, M. A., *Guide to Alaska*, 66, New York, Macmillan, 1950.

⁴ Walker, E., *Smithsonian Institution War Background Studies* 13: 37, 1943.

⁵ *World Almanac*, 93, 1953.

⁶ House Executive Documents, No. 177: 3, 1867-1868.

dilemma, Sumner moved that the treaty be referred to the Committee on Foreign Relations. The motion was carried and a special session of the Senate was then convened on April 1 to consider the treaty. If a vote had been called for at that time, it would certainly have been defeated. Sumner, at first, was non-committal or even opposed to the ratification of the treaty. However, since its defeat might endanger the amity of Russia or give us no other chance to dismiss another European nation from this continent, he decided to support it wholeheartedly. He realized that most of the Senators would be more easily swayed if they were convinced of its economic importance. Accordingly, within nine days, he assembled the data for a speech in favor of the ratification of the treaty.

In the collection of source material for this speech, Sumner leaned heavily on Baird, one of the most famous naturalists of that day, for most of the facts relative to its natural history. Baird had never visited Alaska, but as Assistant Secretary of the Smithsonian Institution, he had aided in the supervision of the study of its natural history for about five years. The Smithsonian Institution and the Chicago Academy of Science cooperated with the Russian American Telegraph Company in exploring the region and collecting natural history specimens. The real leader of this expedition was Major Robert Kennicott, a young naturalist in the service of the Smithsonian Institution, who had already visited the Yukon country and contributed information with regard to the natural history of that region. Baird was also much interested in the region and exchanged long letters regularly with Kennicott. Harry M. Bannister and Ferdinand Bischoff, members of the exploring party, were consulted directly by the Foreign Relations Committee concerning the climate and resources of the area. But the prestige of Baird and his grasp of the total possibilities of the area must have influenced Sumner to call on Baird for lengthy conferences at least five times between March 30, when the treaty was received, and April 9, when it was ratified by the Senate. The list and time of his conferences are recorded in his diary.⁷ One letter by Sumner dated April 3rd is quoted here:

My dear Sir:

I wish you would let me see you at the Senate Chamber as soon as convenient after receiving this

⁷ Archives, Smithsonian Institution, contains Baird's diary and letters.

note. I wish to confer with you about appearing before the Committee of Foreign Relations.

Faithfully yours,
Charles Sumner.

During the week of Senate deliberations, Baird's diary also records conferences with Senator Edmunds of Vermont and Secretary Seward on this same question. In addition, his diary mentions conferences with Baron Stoekl and several others concerning Alaska. Dall, in his biography of Baird, did not mention the part played by him in the purchase of Alaska. He stated that there was a gap in Baird's Journal between 1865 and 1870.⁸ How Dall could have missed that part of the Diary is peculiar because the Journal is preserved in its original state in the Archives of the Smithsonian Institution. The latter depository also contains over 50,000 copies of letters written by Baird as well as an almost equal number received by him.

The treaty was reported by Sumner on April 8 without amendment. The next day he spoke for over three hours on the negotiations for the purchase and on the nature of that area. In this speech, a great many facts, gleaned by Baird from his voluminous correspondence with field observers, were utilized by Sumner. In it he quotes as follows:

The following is the substance of information in regard to Russian America derived from Professor Baird, of the Smithsonian Institution:

Means of information

He has had two explorers in that field between one and two years, who returned last autumn, bringing a complete collection of specimens of natural history, extending from the British possessions to the shores of the Polar sea.

Climate—Temperature

The coast from the Prince of Wales island to the entrance of the Behring straits, during the winter months, has about the same climate and temperature as at Washington city. There is little snow and much rain, and during the summer months the weather is very foggy.

Timber

The whole country, well up to the northern coast, is heavily timbered, chiefly hard pine forests. There are small trees up to the very shores. Some of the islands are heavily timbered with pine forests and

⁸ Dall, W. H. *Spencer Fullerton Baird, a biography*, 385, Phila., Lippincott, 1915.

dense underbrush; some of them are covered with grass of luxuriant growth.

The soil

on the west coast produces excellent barley; and roots, such as radishes and turnips; and esculents such as lettuce, cabbage, &c.

Animals

Furred animals, such as sea otter, river otter, sable, furred seal, mink, foxes, black, silver, red, &c. abound in great numbers. Red deer are on the south and reindeer on the north side.

Fish

Herring, salmon, halibut and codfish abound in exhaustless numbers. In Behring Sea and northward great whales are very numerous.

Minerals

Surface washings of gold have been discovered on the headwaters of the streams on the east side of the Coast range of mountains. The geological developments are the same on the west slopes. Native copper has been discovered in various places on the coast and in the vicinity of Copper river. There is iron now being melted and worked by Russian artisans in repairing ships, &c.

Coal is found in large quantities, and is used by the Russians for naval purposes. It is similar to New Brunswick coal, and not equal to Cumberland coal.

Towards the end of his speech he said about Baird:

Sometimes individuals are like libraries; and this seems to be illustrated in the case of Professor Baird, of the Smithsonian Institution, who is thoroughly informed in all questions connected with the natural history of Russian America.⁹

From the number of conferences Baird had with the top-level government officials and the important part he had in the formulation of Sumner's potent speech before the Senate, it appears that Baird's expert natural history knowledge of Alaska was used to good political advantage. After further debate, the vote was called for on April 9, with 27 in favor and 12 opposed. A proposal to make the vote unanimous failed and the treaty was ratified by a vote of 37 Yeas and 2 Nays. As it turned out, this was the easier half of the battle because the next step in the purchase of Alaska was to convince the members of the

House to pass the appropriation bill for it. The Senators now had to defend their position and therefore persuaded Sumner to have his remarks published.

From April 10 until May 24 when Sumner's speech was published in the *Boston Journal* and other papers, Baird's diary and letters reveal that Sumner asked him to collect more material for the final copy of the speech and to correct proofs. Another letter from Sumner follows:

Tuesday, May 21, 1867.

My dear Professor,

I send you another batch of proofs;—I hope to send the next very soon. Amidst your engagements at the Institution I dare not hope that you can glance at these during the morning but I confess that I should be glad to return them to the printer soon so that they may be corrected. I long to have this work off my hands.

Very truly yours,
Charles Sumner.

The published speech created interest and discussion everywhere. The *Boston Journal*, which published it at length remarked:

This speech, it will be remembered, coming from the Chairman of the Committee on Foreign Affairs, and abounding in a mass of pertinent information not otherwise accessible to Senators, exerted a most marked if not decisive effect in favor of the ratification of the treaty. As might be expected, the speech, is a monument of comprehensive research, and of skill in collection and arrangement of facts. It probably comprises about all the information that is extant concerning our new Pacific possessions, and will prove equally interesting to the student of history, the politician, and the man of business.

At that time the influence of the Administration for the Alaska appropriation was very low because of the impending impeachment proceedings and the lack of prior consultation with the House members concerning this appropriation probably lowered it. A goodly portion of the House members were opposed to the treaty because the country was saddled with huge debts as a result of the recent war. More were convinced it was absolutely worthless or that there were other better large sparsely populated areas with an abundance of natural resources so that the American public would hesitate to plan for the development of the resources of Alaska.

Support for the treaty was evident in scattered parts of the country. In the west, the Pacific

⁹ House Executive Documents, No. 177: 29, 30, 148, 1867-1868.

States pleaded for its purchase because they believed it would be a good investment, giving them fishing rights and a chance to get their ice uninterrupted. Among the earliest supporters in the east was Thaddeus Stevens from Pennsylvania. Several members of the House were impressed with the thought that the purchase of Alaska would remove another flag from the American shore. Others were afraid that if the appropriations were refused it would give us a bad name among the nations of the world and we would certainly lose the friendship of Russia. A few suggested that if we did not buy Alaska it would soon be acquired by the British. Indeed the British had attempted to take it by force at one time. Still the opposition was very strong.

Again there was the necessity of convincing House members of the economic possibilities of the new territory before the measure could pass. Nathaniel P. Banks, Chairman of the House Committee on Foreign Affairs, in his official report on May 18, 1868, quotes Baird on the suitability of Alaskan wood for fishing vessels:

I first called public attention to the Port Orford white cedar in 1851, and, while admitting its many good qualities, have no hesitation in saying that the yellow cedar of Alaska is a much superior wood. It is readily worked, takes a smooth surface, and is remarkably durable. It will make a valuable addition to the cabinet woods of the California market, is superior as a ship timber to any on the coast, and from our short examination, we are satisfied that it may be obtained of ample size for frames and knees of ordinary-sized vessels. At Skalitch anchorage one was measured 18 feet in circumference and estimated over 125 feet in height. A small vessel constructed of this wood over 32 years ago has been a wreck upon the beach for several years and exhibits not the least sign of decay or toredo attacks; the wood around the copper and iron bolts is nearly as well preserved as on the day they were driven. The hulls of all the trading and fishing vessels on this new coast may be constructed of this durable wood upon any of the innumerable bays of the Alexander archipelago.

In another part of the report he discusses the fish population by stating:

Professor Baird, of the Smithsonian Institution, in his report, gives remarkable and without doubt, strange as they seem, perfectly reliable reports of the multitudes of fish.¹⁰

¹⁰ House Executive Documents, No. 177: 32, 1867-1868.

Soon after Senate ratification, individual officials, reporters and explorers sought direct information. On June 4, 1867, the Secretary of the Treasury, Mr. McCulloch, ordered Captain W. A. Howard, of the revenue cutter service, to proceed to San Francisco, to take charge of a cutter, go to the Russian possessions, to acquire a knowledge of the country for the "information of Congress and the people." The Secretary of the Treasury invited Joseph Henry, Secretary of the Smithsonian Institution, to give some suggestions relative to objects of scientific investigation for the expedition under Captain Howard. His reply was as follows:

Your letter informing us that an expedition was to be sent to Russian America, and inviting suggestions as to scientific points worthy of attention, has been duly received, and I beg leave to enclose, in reply, the accompanying memoranda relative to meteorology, ethnology, and natural history, which we should be pleased to have placed in the hands of the gentleman who has charge of the party. The meteorological suggestions were prepared by myself, the ethnological by Mr. George Gibbs, and those which relate to natural history by Professor Baird.¹¹

Reports from this expedition and further debate on Alaska finally led to the passage of the bill on July 14, 1868, making an appropriation of money to carry into effect the treaty with Russia of March 30, 1867. The bill, as finally amended, was passed by the House on July 23, 1869 (91 to 48, 77 not voting), agreed to by the Senate and signed by the President on July 27, 13 months after the ratifications were exchanged. From the closeness of the vote it is seen that there was very little general support for the measure. Baird's influence on the membership of the lower House was definitely felt such as references to him in the Banks' report which was one of the factors in a favorable decision but his weight was not nearly so pronounced as in the Senate where there was only one main source of information on which to make a decision, Sumner's speech, which was made with cloth containing the Baird fabric. It has often been mentioned that perhaps bribery had a lot to do with the outcome of the vote in the lower House. An investigation by the House later in the same year disclosed that Robert J. Walker and Frederick P. Stanton had been engaged and paid for as counsel and that John W.

¹¹ House Executive Documents, No. 177: 192, 1867-1868.

Forney had been paid for journalistic services but no Congressional bribe was established. It also was shown that Stoekl never dispatched more than about \$7,000,000 to Russia.

But the manner and wisdom of the purchase was questioned for years and there was general

hesitation to appropriate funds with which this purchase would become a profitable account. It was almost thirty years before the prophecies of Baird relating to natural wealth were realized and many more until Alaska became a real outpost such as Seward dreamed of.

A SOCIOLOGICAL VIEW OF AGING

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(Read April 23, 1953, in the Symposium on Social and Economic Problems of Aging)

HUMAN aging is not a new phenomenon, and aging has always had sociological aspects. There have always been some who have lived to advanced years, as Dr. Notestein has shown¹ and some of these have become infirm and more or less useless. Their societies were forced to determine what disposition should be made of them.

More recently, a number of factors have combined to raise aging to a matter of first magnitude and of national concern. Few developments have swept the public awareness more rapidly. Nationally, statewide, and locally, organizations, groups, and individuals have turned their attention to the study of aging and to the development of programs and services designed to facilitate individual and social adjustment to it.

While aging is usually described in terms of physiological and psychological changes taking place within the individual, it is also subject to sociological definition. Sociologically, aging is a function of situational changes which the individual begins to experience, characteristically, in the late forties and most of which are associated with his role in society. In essence, it may be seen as the completion of or the inability to carry on conventional roles and the failure to find new ways of continuing as a functional, integrated, self-sufficient member of the family and the community. Underlying basic needs appear to continue throughout life, but the opportunities for satisfying them become restricted.

INDIVIDUAL AGING

Traditionally, adults in human society have been assigned two principal functions from which they have derived social recognition or status and the satisfactions of human companionship. These functions have been: (1) perpetuation of the species and preparation of the young for adulthood, and (2) maintenance of the economy and the social organization through demonstrated con-

¹ Notestein, Frank W., Some demographic aspects of aging, *Proc. Amer. Philos. Soc.* 98 (1): 38-45, 1954.

tribution in some form of productive, paid employment.

The period of procreation and parenthood is terminated during the forty-five to fifty-five year decade of life when children leave home to establish their own families. Thus, one adult function is completed at what is coming to be regarded as middle life. The woman who has devoted her early adult years to motherhood is faced with the need for new activities and contacts through which she can derive a sense of usefulness or purpose, social recognition, and companionship. Men, together with women who have occupations outside of the home, experience the same needs but in lesser degree.

The period of gainful employment comes to a close for some with the rising incidence of long-term illness and disability beginning in the fifties. A much sharper increase in unemployment occurs in the sixties when compulsory retirement policies become operative. Paralleling these two factors is the retirement occasioned by the relative inability of persons beyond fifty years of age to find jobs when they become unemployed for technological or other reasons.

There is a good deal of evidence that, as retirement age approaches, most workers shrink from it, sensing the implications of reduced income, the loss of social contacts, and the completion of purposeful activity.² Most self-employed workers appear to taper off by cutting down on responsibility or reducing hours rather than stopping abruptly.

Aging has other facets, too. Illness and energy decline force the individual to modify his behavior in a variety of ways. The incidence of widowhood rises among men after middle life and quite sharply among women. At age sixty-

² Hall, Harold R., *Some observations on executive retirement*, Cambridge, Mass., Harvard School of Business, 1953. Tuckman, Jacob, and Irving Lorge, *Retirement and the industrial worker*, New York, Columbia Univ. Press, 1953.

five years, about one-half of today's women are without husbands. Finally, social attitudes tend to disparage the capacities of older persons and to encourage their withdrawal from active participation.

These several factors, taken in combination, result in a good deal of personal frustration and disorganization. Many older people today report feelings of uselessness regarding family and community, experience a great deal of loneliness, have developed self-concepts of deterioration, and are worried over real or threatened dependency, insecurity, and poor health. Interests become constricted; irritability and depression set in and are frequently followed by withdrawal, paranoid tendencies, and submission.³

SOCIAL FACTORS IN AGING

How has this situation come about? Why does this growing population of older persons tend to appear as a displaced segment in our society? Briefly, the explanation seems to lie in the same matrix of scientific invention and discovery that have added twenty years to average life expectancy since the turn of the century.

Technological development and industrialization have increased our output per worker three and one-half times over the past one hundred years.⁴ The increase could have been still greater had we not shortened the hours of work, postponed the entrance of young people into the work force, and developed the pattern of retirement for older workers. The proportion of men aged sixty-five and over in the work force has declined from about 80 per cent in 1870 to 42 per cent today. Problems arise because of financial insecurity and the absence of satisfactory substitute activities.

Urbanization, another consequence of industrialization, aggravates the retirement problem. In rural societies, the aged have traditionally retained some form of useful activity and close contacts with family and friends. They have tended to remain integrated within the primary group society. Urban life, however, is highly competitive, rational, and impersonal. The older person less frequently finds opportunity to be useful, becomes

separated from children and former associates—tends, in short, to become isolated and lost.⁵

Family life also has become less favorable to older adults. The pre-industrial consanguinal family was, characteristically, an economic unit. In the subsistence economy, all three generations were useful; grandparents found plenty to do within the security of the family fold. Today, many functions have been removed wholly or partially from the home. Most workers are employed by others away from home. Home appliances, prepared foods, laundries, and restaurants have lightened household tasks. Few middle generation families need the older people, few are able to support them, and few have room for them. The conjugal family is the typical one and the older parents are having to make their own lives.

Aging in American life is, then, a function of an increasing number of persons living beyond the period of traditional adult roles, many, perhaps the majority, of whom have not found new opportunities for satisfying activity, maintenance of self-respect, social participation and affection. In addition, there are the problems of health and income mentioned earlier.

AGE IS OPPORTUNITY

As nearly as current observation and research enable us to draw it, this is the picture of aging at mid-century. Fortunately, there is another side to it—a side that is being well demonstrated here today. For the individual, leisure and freedom from earlier adult responsibilities affords opportunity hitherto scarcely dreamed—opportunity for activities postponed during a busy life, for appreciation of the culture, for indulgence of new interests and skills, for broadened social contributions—in short, opportunity for full self-realization, through new forms of development and expression.

What is more, evidence is accumulating that this outlook for the later years is a perfectly feasible and healthful one. In the first place, it is important to recognize that senescence is normally a very gradual process covering a period of perhaps thirty to fifty years. Furthermore, it is a highly differential process, both within the individual and among individuals.

Secondly, the same factors that are extending expectation of life are undoubtedly operating to sustain the quality and function of the older or-

³ Sands, Irving J., *The neuropsychiatric disorders of the aged*, *New York State Journal of Medicine* 51: 2370-2375, 1951.

⁴ Woytinsky, W. S., and E. S. Woytinsky, *World population and production*, Chap. 12, New York, The Twentieth Century Fund, 1953.

⁵ Hauser, Philip M., *Facing the implications of an aging population*, *Social Service Rev.* 27: 162-176, 1953.

ganism. Each new discovery in prevention of illness or breakdown, in therapy, and in physical restoration represents another achievement in this direction.

Finally, the fact is frequently overlooked that senescence is by no means entirely a period of either relative or absolute decline. Simplification of tasks and substitution of machines and power for human energy prolong the period of performance capacity. Furthermore, Welford has shown that one function of maturity is the development of compensations to offset loss of strength and endurance.⁶

Older people repeatedly demonstrate that learning capacity is little diminished with the years, provided it is exercised. Knowledge and experience are cumulative, thus increasing capacity for making judgments. Verbal ability holds up well, and may even increase among the more intelligent and better educated. Youth's impulsiveness and the conformity of young adults may give way to deliberation and tolerance.

In the present connection, it may be stated parenthetically, that there is a good deal of basis for suggesting that much physiological and psychological regression—premature aging—is due to lack of stimulation and gradual withdrawal from physical and mental activity.⁷ Some of the personality changes, previously mentioned, may be prevented, if security and opportunity for continued social participation can be maintained.

In summary, then, the current hypothesis is that an old-age environment which encourages activity may convert the later years, despite certain characteristic declines, into an extended period of satisfying growth and development.

From society's point of view the challenge is equally great. Courtney and Linden, here in your own community, have suggested that the natural inclination of those who have completed the child-rearing cycle is to seek ways in which they may help to preserve and improve the culture for the oncoming generations.⁸ The appearance of a new and large group of mature adults, freed from restrictive responsibilities and capable of high-level

performance may, indeed, represent a new stage of industrial civilization. We may find in this new generation, as we are already beginning to do, the potential for a vast senior citizenry, eager to broaden their education, to understand the great social issues of the day and participate in wise decision-making, and to aid in closing the growing gap between the profound technological changes and our system of social values and standards of social well-being.

IMPLICATIONS FOR SOCIETY

The third phase of this discussion has to do with the implications of aging for American society. It seems to me that we are faced with a clear alternative. We can, on the one hand, maintain our present concept of aging and continue to regard the later years as a period of decline and diminishing usefulness and encourage the withdrawal of older people from active participation in the affairs of the community. If we do so, I believe we can be fairly certain of vastly increasing that segment of the population which sees nothing but futility, social isolation, and insecurity in the period beyond middle life. We shall continue to foster premature physical and mental breakdowns and add enormously to the social and economic burden of middle-generation families and of our health and welfare services.

The other alternative is to embrace the second concept I have tried to develop. If we do so and if we make the social adjustments required, we can foresee new vistas for personal growth and satisfaction and a new reservoir of energy, wisdom, and creative imagination available for improving the total human welfare. An active, contributing body of older adults will hold the costs of illness, infirmity, and dependency to a minimum.

I have indicated that either view of aging we wish to accept carries with it profound implications for society and for the individual. Adopting what I believe to be the new and positive concept, I wish to conclude by suggesting some of the conditions that will have to be created if it is to have force and vitality and to give new direction to older lives.

First of all, is the requirement that we abandon current stereotypes and change our attitudes toward a good deal of the aging process and aging people. We shall have to recognize maturity as a period of potential growth, continuing function, and expansion rather than contraction of interests.

⁶ Welford, Alan T., and others, *Skill and age, an experimental approach*, London, Oxford Univ. Press, 1951.

⁷ Donahue, Wilma, Psychological aspects of aging, *Problems of America's aging population* (edited by T. Lynn Smith) 47-65, Gainesville, Univ. of Florida Press, 1951.

⁸ Linden, Maurice E., Growing up or growing down: the challenge of the geriatric patient, *Danville State Hospital Mental Health Bull.* 30 (3), 1952.

The second condition, as I see it, is that we must find new roles for older people and create a system of values that will give meaning or attach importance to these roles. It seems to me that there are four areas of activity worthy of exploration. One of these is increased utilization of older persons in the existing occupational structure. There are clearly some tasks for which mature workers have assets that are not possessed by younger persons. And there are some occupations in which there are current and not temporary manpower shortages that can be relieved only by the employment of women who have passed by or through the childbearing period. We can also quite arbitrarily shorten the work week still further and we can place more jobs on a part-time basis, thereby taking advantage of older worker experience and at the same time permitting the older worker to maintain his own income security and develop avocational interests.

Next, it seems to me that we have already entered the stage of developing a number of new occupations. We have begun to see that the rising population of older people will require a good many services suited to their particular needs. Thus, we are already finding the development of facilities for health, vocational, financial, and personal advisement; for adult education; for work in arts and crafts; for recreation and camping; and for special housing situations, as well as for rehabilitation, housekeeping assistance, practical nursing, and sheltered living arrangements. I think I am on safe ground when I predict that mature persons are the better qualified for work with older people.

Another area of potential usefulness is the field of creative work in the fine arts and handicrafts. One result of our great productivity is that we have more time and money for the development and appreciation of the non-material or aesthetic aspects of our culture. Although we have no quantitative measurements, I believe a good many middle-aged and older persons are finding satisfaction in learning and practicing these skills. Some are finding in them a means of income supplementation. A variation is found in the applied arts—dressmaking and millinery, interior decoration, and home maintenance—through which older persons are enabled to stretch their fixed-income dollars.

The final and less tangible activity or role area, and to which I have already referred, is that of voluntary community service and citizenship. A

great deal of useful work is performed by those who find satisfaction in contributing free time and energy to the maintenance of community health, welfare, and recreational services; to advisory boards to community agencies; and to developing intensive interest in civic or political affairs. In this, as in the area of creative activity, the principal problems seem to be those of drawing the individual out, preparing him for his new responsibilities, and giving him suitable recognition or status for the tasks he performs.

Now, I shall turn to the third and last characteristic of a climate favorable to continued functioning. First, we shall have to make provision for adequate incomes if we are to persuade older individuals to accept and grow into new and responsible contributory roles. I do not believe we can expect the older person who is continually threatened with financial insecurity to function adequately in social situations. It is a plain fact that too large a proportion of today's older population is threatened with financial insecurity and that many are unable to maintain the nutrition, health, appearance, and dignity required for participation in family and community life.

Beyond mere income, an active older population will need facilities and services that meet their needs for the preservation of health and restoration of function following illness; vocational adjustment; identification of new activities or roles; personal adjustment to loss of children, spouses, and friends; adjustment to long-term illness, to retirement and reduced income; suitable living arrangements; opportunity for recreations; and desire for continuing education.

There are two points regarding these facilities and about this whole environmental matter on which we must be perfectly clear. The first is that the facilities and services mentioned above are not welfare services in the sense of shoring up a population of social and medical dependents. Instead, they are the components of a normal environment for normal people entering a new phase of life with its own characteristic needs and problems. Just as we are already providing an environment suited to the requirements of growing children and young adults, we must now offer corresponding facilities for the fully mature and the aged.

The other point is that provision of this environment is a community responsibility. It is obvious that older people cannot provide it for themselves. And it seems equally apparent that

it is no longer practical to regard it as a family responsibility. Continuing separation of the older and younger generations calls for full recognition of the need for self-sufficiency and relative independence of one from the other. When we create the appropriate community climate, we can be sure the aging adult will retain the initiative in seeking solutions to his problems and outlets for his interests and energies.

SUMMARY

This sociological approach to the subject sees aging as a completion of customary adult social roles at the usual chronological ages while average life expectancy is being extended. Sociologically,

aging is a consequence of the matrix of scientific inventions and technological progress which have lengthened life and lightened the tasks of subsistence.

The problems growing out of aging include income and health maintenance, discovery of new roles that satisfy needs for status and participation, and preservation of close relationships with family and friends. But aging is also seen as opportunity for full self-realization of the individual and for social improvement.

Conditions essential to attainment of these goals are: revision of attitudes toward aging; development and acceptance of new roles for older people; and creation of a climate in which older adults are encouraged to remain functional and self-sufficient.

ANTICIPATIONS AND SOCIAL CONSEQUENCES OF ATOMIC ENERGY

LEWIS MUMFORD

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(Read November 12, 1953)

THE period in which we live is characterized by strange inner contradictions. While the advance of science has placed energies of cosmic magnitude at human disposal many institutions have regressed to the lower levels of barbarism. The most rational procedures of science now have as their end product in the human economy wholly irrational goals. While the venerable sage, Albert Schweitzer, receives a Nobel peace prize in recognition of his urgent summons to practice reverence for all life, the scientific laboratories of the world are busy with researches whose full-scale application in war might put every living species in peril. On one hand, our national government withholds from its citizens the knowledge needful to make sound judgments on military policy; but at the next moment the same authorities warn us that with the instruments now available, the price of victory in another war might be the extermination of the human race: a curious conception of military success. By the automatic advance in scientific knowledge, we are now committed to processes whose tempo we do not dare to retard, whose direction we do not govern, and whose ultimate results we do not stop to evaluate. Under such conditions every permission becomes a compulsion. And as long as our present knowledge continues to expand the sphere of the irrational and the pathologically automatic, the survival of man, to say nothing of his development, is plainly threatened.

The dangers of our present situation would not be so great had our responses to it been alert and timely. Even now, we should probably be able to mobilize enough political wisdom to provide a minimal basis for the necessary cooperations and safeguards, if only we could throw off the sleep-walker's insulation from reality that characterizes our collective conduct. There are doubtless many causes and reasons for this feebleness of response, and I would not pretend, within the compass of this paper, to give even a sketchy account of them. I purpose rather to confine attention to a single

aspect of our present lapse in rational judgment and responsible action: that to which the sciences themselves have contributed by the very terms of their own development. And I do this, not to throw any blame on our colleagues in the natural sciences, but to open the way for a discussion of the means by which scientists themselves might rectify past procedures by setting an example in social responsibility and sanity.

The immediate failure to evaluate and exercise a timely control over the forces whose very existence now threatens us, has its origins, at least in part, in a fatal choice that was made in the name of scientific freedom in the seventeenth century. This decision may be symbolized for us by the resolution of the Royal Society of London, at its very inception, to confine its discussions and experiments to the field of the natural sciences, and to omit all concern with matters that traditionally belonged to theology and history. The necessity to escape the limitations of purely subjective inquiry was obvious; but in defining scientific truth, in the terms Galileo and Descartes defined it, as a truth detached from all considerations of purpose, value, or practical application, science cut itself off from all human concerns except those of science itself. The new absolute for the scientist parodied the old Roman legal maxim: Let scientific truth be discovered, though the heavens fall. The unstated assumption in this maxim was the confidence that the heavens would not in fact fall.

Happily for the health of scientists as human beings, their general conduct did not always live up to the strict isolationism of their creed. Some of the greatest minds in science, indeed, from Pascal to Clerk Maxwell, never lost touch with the ultimate questions of human destiny, while still others, like Joseph Henry and Louis Pasteur, took seriously their obligations as citizens. Nevertheless, for the last three centuries, the whole weight of the scientific tradition has been on the side of detachment, of social irresponsibility, of non-con-

cern for the uses other men might make of scientific knowledge, even though with the growth of biology and medicine strictly human interests—like those of Pasteur's wine growers—insistently invaded the laboratories. To evaluate the human results of their work, to anticipate its possible applications, to correlate the advance of science with the development of man no more occurred to scientists in pursuit of their isolated system of truths than it occurred to the capitalist enterpriser of the nineteenth century, in his equally abstract and one-sided pursuit of financial gain. Plainly, in the seventeenth century, the causal and the teleological had parted company: if one were free to analyze causes one could, so to say, damn the consequences. Beneath that belief there was another unstated assumption, implicit in the very conception of progress, namely that knowledge was, as Bacon had said, power, and that power, power over the forces of nature especially, was an unqualified good. In leaving out the prophetic concerns of Jewish and Christian theology, science had also lost insight into the dangerous liaison between power and pride: the power that lays traps for vanity and the pride that cometh before a fall.

So successful was this new methodology of science that every other scholarly discipline, even in the humanities, tended to ape science's procedures and to proclaim a similar indifference to social results. When in 1910 Henry Adams sought with almost clairvoyant anxiety to enlist his fellow-historians in an assessment of the new physical forces that were so swiftly transforming Western Civilization, they turned a deaf ear to his remarkable paper because it was concerned not with past certainties, but with potentialities and future probabilities.¹ As a result of these widespread habits of thought, mankind entered the atomic age without looking before or after, and therefore without the faintest preparation for the drastic changes in human institutions that must result, changes that might even affect the speed and direction of scientific effort itself. Yet the outlines of this age, the dimensions of its problems, were visible at least a generation before the first atomic bomb was detonated. Ever since Becquerel's discovery of radioactivity the old stabilities and securities had been visibly threatened. Sensitive observers were at hand who saw that without a radical readaptation of human institutions, these new forces might

be ungovernable, and prove in the end perhaps fatal. As early as 1905 Henry Adams, writing to Henry Osborn Taylor, had observed:

At the present rate of progress since 1600, it will not need another century or half century to turn thought upside down. Law in that case would disappear as a *priori* principle and give place to force. Morality would become police. Explosives would reach cosmic violence. Disintegration would overcome integration.

By 1913 the novelist H. G. Wells, under the spell of the physicist, Frederick Soddy, went further: in his novel, *The World Set Free*, he depicted the use of the atom bomb in warfare, with the total demolition of the first city attacked. Finally, in 1919, Rutherford's critical demonstrations had transformed these timely anticipations into a well grounded probability. If these fitful prophecies had been backed by systematic speculation and inquiry, undertaken by men of science, we should have had a whole generation to prepare mankind for the coming transformation. Instead, we fell into the atomic age with as little anticipation as an abstracted walker, looking for pennies on the pavement, might fall into an open manhole. The manhole was visible; but we regarded the scientific pennies as more important.

One further result must be noted, in our failure to anticipate the social consequences of scientific progress and to direct it to humanly valid goals; and this is the fact that the last feverish efforts to place the inordinate powers of nuclear fission under human control took place under the restraints and compulsions of war, when small men were prompted to large decisions under the pressure of the moment, without anything like a careful canvass of alternative policies and means. Had the whole situation been examined in time, the atomic crisis might have been averted. There were two variables that it was imperative to bring under control, during the thirty years before the atom bomb was invented: one was the rate of scientific advance and the other was the rate of social adaptation. Neither of these variables is an impersonal, uncontrollable force of nature. The rate of scientific advance is conditioned by policies of education and recruitment, by budgetary provisions for universities and research laboratories; by the amount of social approval accorded to science itself. If we had become as skeptical of the value of science as were St. Augustine and his contemporaries, science could have been starved

¹ See "A letter to American teachers of history" in Adams, Henry, *The degradation of the democratic dogma*, New York, Macmillan, 1919.

out of existence in less than a generation. General social adaptation, though a more complex and laborious process, is likewise no purely automatic response to uncontrollable conditions. But because of the failure of our anticipatory reactions, which are the very core of intelligent behavior, decisions of utmost importance to human welfare were made, for purely military purposes, in the midst of a conflict that had already destroyed ancient inhibitions against the random extermination of life. Cosmic power plus moral nihilism is, as Henry Adams had vigilantly predicted, a formula for general disintegration. This was a case of negative social adaptation. The forces that should have been retarded were accelerated.

Now, to the honor of the scientists who produced the atomic bomb, the consciences of their leaders suddenly took fire as soon as man-controlled nuclear fission proved possible. If the awakening was too late to keep these distinguished minds from becoming accessories before the fact, it was also too partial to enable them to bring about a more general social awakening. On their own calculations, as set forth before the Senate Committee on Atomic Energy (1945-46) three years, at most five, was the limit for maintaining a national monopoly of the new weapon. They did their best, in this brief time, to repair the damage caused by their century-old indifference to social consequences. But their best was not good enough. To have aroused mankind fully to the extent of political invention and moral rehabilitation needed to provide even a minimal security, the actions of the scientists would have had to speak even louder than their words. They would have had to close their laboratories, give up their researches, renounce their careers, defy their governments, possibly endure martyrdom, if they were to convey to the public the full urgency of their convictions. Here the new sense of social responsibility failed to overcome the neutralist habits of many lifetimes. Even those who were most deeply disturbed by the possible misapplications of science continued to apply themselves to science. And while "science as usual" prevailed, it was fanciful to hope that "business as usual" and "politics as usual" could be shaken out of their rut.

If this diagnosis is even partly sound, one must now ask a further question. Does it still lie within the province of science to provide any correctives for the evils that its own practice of insulation—abetted by its sudden intrusion into the

fields of politics and war—has contributed to? At this late moment, plainly, we must work against time, with the materials now available. Laudable as may be the new Society for Social Responsibility in Science, one cannot hope for immediate results from its efforts. Is it presumptuous, then, for a philosopher to suggest that, within the realm of science itself, there are still resources that might be brought into more active play: the tradition of free inquiry, the collective pooling of knowledge, the lifting of truth above all self-imposed privacies and official restrictions that hamper its circulation among men. Without violating any prudent military taboos against the disclosure of technical means, the scientists themselves are in a position to examine and weigh the probable consequences of utilizing, to this or that extent, the agents of destruction and extermination that are now available. Even the premature peacetime exploitation of this double-edged power, before we have found any practical means of disposing of the waste-product, must be subject to searching criticism. Our present disgraceful record in the industrial pollution of air and water should forewarn us against the grave likelihood of an irretrievable pollution by atomic wastes.

In other words, what scientists failed to prepare for through the period between 1910 and 1940, when the atomic age was just over the horizon, is at least open to them now, when potentiality has become actuality, when prophecy has become accomplished fact. The ill-fated consequences they refused to anticipate then now lie before them. These consequences await methodical inspection and assessment by the only body of men capable of performing it: the scientists themselves, acting as a comprehensive faculty, drawing on their membership in every related field, from nuclear physics to bacteriology, from chemistry to embryology and psychiatry. Why should they not meet in a World Congress, under the aegis of the United Nations, and pool their data as to the effects of utilizing atomic energy in wartime extermination. Let them gauge the prospective results in terms of millions of lives exterminated, of slow-dying cripples and embryological monsters in various species, of vegetation wiped out, ecological partnerships ruined, water supplies contaminated, soil and atmosphere permanently poisoned. Let them even consider the traumatic effects on the personality of our present preparations for these events, already observable, and the worse traumas to be anticipated from their becoming an actuality.

In other words, let the scientists, duly assembled in a World Congress, make a qualitative and quantitative analysis of the probable outcome of a world war in which the opposing nations used these new weapons of genocide. No living mind possesses all these data; indeed, no single group of scientists can supply it: it is only in conference that the facts can be established and the threat to life dispassionately estimated. Possibly such a full dress rehearsal in the mind would keep the world from raising the curtain on the malign drama itself. At all events, it would be better to face the consequences in advance than attempt, at the last minute, to avert them, like the physicists who sought, too late, too naively, too ineffectually, to prevent the exploitation of the atomic bomb. Let the truth now be told, as perhaps the one means left to keep the heavens from falling.

There is, I submit, nothing in this Great Assize of scientific knowledge, undertaken, not to promote a national interest but to safeguard the human race, that is foreign to the procedures and purposes of science itself. In such a Congress, the scientists would confine themselves to observable results and statistical probabilities alone. In proposing to meet for such a purpose they would challenge the questionable practices that have broken down world-wide communication in the sciences and restricted not only international communication but cross-reference among practitioners in different fields. But their task would be the task of reasserting the integrity and moral responsibility of science itself, as accountable to mankind for correcting, within its own department, the evils that might issue from the incontinent or demoralized exploitation of scientific knowledge. This scientific congress need draw

no military or political conclusions: they need suggest no practical steps. Their sole job would be to provide the data on which rational conclusions could be drawn and alternative policies formulated. If mankind actually lives under the grave perils at which our military and political leaders so grimly hint, there is probably a sufficient instinct for survival left in the human race to take the necessary measures of self-protection once the facts are known.

Admittedly, this proposal for a World Assize of scientific knowledge on the effects of atomic bombs, hydrogen bombs, and other means of effecting total genocide, is not a panacea: it is at best but a first step toward stirring the fresh intellectual currents that may clear the air and prepare the way for further cooperative action. Nor is the proposal a novel one. In something like its present form, it was put forward six years ago in *Air Affairs*; and independently it was broached again the other day by the mathematician and philosopher, Bertrand Russell. But it as yet lacks the only support that could make it effective: the resolute corporate backing of the scientists themselves. Suggestions of similar nature have been made from time to time by individual scientists, but popular ignorance of the total danger to life, overt governmental hostility to an open revelation of erroneous policies, and moral neutralism among the great body of scientists have effectually nullified these efforts. Will scientists re-orient themselves in time to re-orient the world; or are they committed to a passive acceptance of the catastrophes their old tradition of social irresponsibility helped to create? That question is not for me to answer.

ON OFFICIAL CORRUPTION IN ROMAN EGYPT: THE EDICT OF VERGILIUS CAPITO*

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GNAEUS VERGILIUS CAPITO was Prefect—i.e., governor—of the province of Egypt during part of the reign of the Emperor Claudius.¹ On the outer gateway of the temple at Hibis, in the Great Oasis west of Thebes, is inscribed the Greek text of an edict which Capito issued in Alexandria on December 7, A.D. 48, and ordered posted throughout the province. This has been for over a hundred years one of the best known inscriptions from Roman Egypt, figuring repeatedly in studies of the provincial administration.²

It was apparent from the start that the edict was directed against certain official abuses. A large step forward toward clearer understanding came in 1899 with Ulrich Wilcken's brilliant insight into the administrative machinery involved.³ In one fundamental respect, however, the interpretation of the edict has remained unchanged to the present day. In the view of all

commentators the Prefect's edict orders an end to the extortionate demands for accommodations, provisions, and transportation facilities made upon the population by military personnel and civilian officials when traveling through the country.⁴ This view would appear to be firmly supported by a sizable body of literary, epigraphical, and papyrological evidence which proves that such extortion was common and widespread in the Roman provinces.⁵ It is the purpose of this paper to show, however, (1) that Capito's edict has been fitted into this familiar

* This paper is a first product of a comprehensive study of compulsory public service in antiquity recently undertaken with financial assistance from the Penrose Fund of the American Philosophical Society, whose support of this research is here gratefully acknowledged.

¹ Capito is known to have held the office from A.D. 47 to at least 52.

² Yet, oddly enough, a definitive text of the inscription has been available only in the last fifteen years. Before that the "standard" text, based on various imperfect copies taken in the nineteenth century, was No. 665 in Dittenberger, W., *Orientalis graeci inscriptiones selectae* 2, Leipzig, Hirzel, 1905, reprinted as No. 1262 in *Inscriptiones graecae ad res romanas pertinentes* 1, Paris, Leroux, 1911. An inspection of the inscription by P. Jouguet in the course of a brief visit to the Oasis produced substantial improvements in reading, which were published by him in *Atti del IV congresso internazionale di papirologia*, 4-22, Milan, "Vita e pensiero," 1936, and reprinted as No. 794 in *Supplementum epigraphicum graecum* 8, Leyden, Sijthoff, 1937. The definitive text, derived from photographs and a long and careful study of the original by H. G. Evelyn White a quarter-century earlier, was published by J. H. Oliver as No. 1 in *The Temple of Hibis in El Khargeh Oasis, Part II: Greek Inscriptions*, New York, Metropolitan Museum of Art, 1938.

³ Wilcken, U., *Griechische Ostraka aus Aegypten und Nubien* 1: 389-390, 501-502, 572, Leipzig and Berlin, Giesecke and Devrient, 1899.

⁴ Franz, J., *Corpus inscriptionum graecarum* 3: 445, Berlin, 1843; Wilcken, *op. cit.*, 501, 671; Dittenberger, *op. cit.*, 377, note 22; 379, note 35; Rostowzew, M., *Klio* 6: 255, 1906; Martin, V., *Les épistatèges*, 143, Geneva, Georg, 1911; Oertel, F., *Die Liturgie*, 92, Leipzig, Teubner, 1917; Lesquier, J., *L'armée romaine d'Égypte*, 363, Cairo, Institut français, 1918; Milne, J. G., *A history of Egypt under Roman rule*, 3d ed., 160-161, London, Methuen, 1924; Abbott, F. F., and A. C. Johnson, *Municipal administration in the Roman empire*, 509, Princeton, Princeton Univ. Press, 1926; Uxkull-Gyllenband, W., *Der Gnomon des Idios logos*, 50, Berlin, Weidmann, 1934; Jouguet, *loc. cit.*, 4-12; Johnson, A. C., *Roman Egypt*, 624, Baltimore, Johns Hopkins Press, 1936; Pflaum, H. G., *Mémoires présentés . . . à l'Académie des Inscriptions et Belles-Lettres* 14: 229, 1940; Taubenschlag, R., *The law of Greco-Roman Egypt in the light of the papyri* 1: 343, New York, Herald Square Press, 1944. See also note 6, below.

⁵ Some of these documents will be cited in the ensuing discussion. For further details see the editions of the texts cited in notes 8 and 9, below, and Rostovtzeff, M., *The social and economic history of the Roman empire*, 334, 363-364, Oxford, Clarendon Press, 1926. Although civilian officials as well as military personnel were involved in these abuses, it is probable that the latter, whether because they were armed or because they were more often on the road, were the chief offenders. This may be why Capito in his edict enumerates "soldiers, cavalrymen, orderlies, centurions, military tribunes," but does not similarly specify any particular categories of civil servants (cf. Pflaum, *loc. cit.*). A similar edict issued in A.D. 133/137 by the Prefect Marcus Petronius Mamertinus also focuses its attention on soldiers as the culprits: cf. Rostovtzeff, *op. cit.*, 592, note 34 (this edict—No. 446 of the *Publicazioni della Società italiana per la ricerca dei papiri greci e latini in Egitto* 5: Florence, Ariani, 1917—is reprinted with English translation as No. 221 in Hunt, A. S., and C. C. Edgar, *Select papyri* 2, London, Heinemann, 1934 [*Loeb Classical Library*]).

framework only by dint of involving its language in a whole series of strains, ambiguities, and even contradictions, which are quite intolerable in a promulgation addressed to the general public; and (2) that the abuse against which Capito's edict was directed was in reality the soldiers' and officials' fraudulent practices in the expenditure of state funds for their personal convenience when traveling—that the issue here, in other words, is not extortion but the padding of expense accounts, not milking the populace but bilking the fisc.⁶

The edict reads as follows:⁷

- Γραῖος Οὐ[εργί]λιος Καπίτων λέγει *vacat*
 15 και πάλαι μὲν ἤκουόν τινας δαπάνας ἀδίκους και παραλογή-
 αι ὑπὸ τῶν πλεονεκτικῶς και ἀναιδῶς ταῖς ἐξ[ο]υσιαῖς ἀπο-
 χρωμένων γείνεσθαι, και νῦν δὲ ἐν τῇ τῶν Λιβύων μάλιστα
 ἔργων ὑποθέσει ὅτι ἀναλίσκεται τινα ἀρπαζόντων ἀδε-
 ῶς τῶν ἐπὶ ταῖς χρεῖαις ὡς ὑποκείμενα εἰς δαπάνας
 20 και ξενίας αὐτῶν τὰ μήτε δυντα μήτε ὀφείλοντα εἶναι,
 ὁμοίως δὲ και ἀργα[ρ]ειῶν ὀνόματι. διὸ κελεύω τοὺς
 διοδεύοντας διὰ τῶν νομῶν στρατιώτας και ἱππεῖς και
 [σ]τάτορος και ἑκατοντάρχας και χειλιάρχους και τοὺς λοι-
 ποὺς ἅπαντας μὴδὲν λαμβάνειν μὴδὲ ἀργαρεύειν εἰ μὴ
 25 τινες ἐμὰ διπλώματα ἔχουσιν· και τοὺτους δὲ στέγηι μόνον δέ-
 χεσθαι τοὺς διερχομένους, ὑποκείμενόν τε μὴδένα μὴδὲν πράτ-
 τειν ἔξω τῶν ὑπὸ Μαξίμου σταθέντων. [ἐ]ὰν [δ]έ τις δῶι ἢ ὡς δε-
 δομένον λογισηται και εἰσπράξῃ δημοσίᾳ, τοῦτον τὸ δεκαπλοῦν
 ἐγὼ ἐκπράξω οὐ αὐτὸς ἔπραξεν τὸν νομόν, και τῷ μνήσαντι
 30 τὸ τέ[τρ]απλάσειον μέρος δώσωι ἐκ τῆς τοῦ κατακριθέντος οὐσί[α]ς.
 οἱ [δὲ] βασιλικοὶ γραμ[μ]ατεῖς και κωμογραμματεῖς και τοπογραμ-
 [μα]τεῖς κατὰ νομόν πάντα ὅσα [δ]απανᾶται ἐκ τοῦ νομοῦ εἰς τινα
 ἢ πέπρακται παραλόγως ἢ ἄλλο τ[ι] ἀναγραφ[ε]σθωσαν και ἐν ἡ[μέ]ραι[s]
 35 ἐξήκοντα ἐπιδότωσαν, οἱ δ' ἐπὶ τ[ῆ]ς Θηβαίδος διὰ τετραμήνου, εἰς τὰ
 λογιστήρια, και πρὸς Βασιλεῖδην τὸν Καίσαρος ἀπελεύθερον, τ[ὸν] ἐπὶ
 τοῦ λογιστηρίου, και τοὺς ἐκλογιστὰς πεμπέτωσαν, ἢ ἐὰν τ[ι] παρὰ τὸ δι-
 καιον λελογευμένον ἢ πεπραγμένον ἢ, τοῦτο διορθώσομαι.

The remainder (about two-thirds) of the edict, though too mutilated in its present state to give reliable continuous sense, evidently dealt with different, if related, matters.

From an unprejudiced reading of the above text there emerge two major controlling considerations for its interpretation.

⁶ Scramuzza, V. M., *The Emperor Claudius*, 273-274, Cambridge, Harvard Univ. Press, combines a glimpse of the fact that "illegal expense, waste, graft" are involved with a grotesque distortion of the remainder of the edict: see below, notes 21 and 25.

⁷ Capito's edict begins with line 14 of the inscription; the preceding thirteen lines are occupied by the letters of transmittal that accompanied the edict.

I. There is no clearly demonstrable mention of extortion

In the Greek vernacular of the eastern Mediterranean in Hellenistic and Roman times, extortion was expressed by *διασειώ* and other compounds and derivatives of the verb *σειώ*⁸—almost literal equivalents of our slang term "shake down"—and by similar language carrying an unmistakable imprint of intimidation and compulsion.⁹ Such language is significantly absent from Capito's edict:

1. It is true that the traveling officials are at one point called "plunderers" (line 18,

⁸ E.g., Abbott and Johnson, *op. cit.* (note 4), No. 141: *διασειόμεθα δὲ παρὰ τὸ ἄλογον και παραπρασσόμεθα* (lines 14-15; similarly lines 20-23 and 31). For other examples in inscriptions see *ibid.*, Nos. 143, 144; for the papyri cf. Preisigke, F., *Wörterbuch der griechischen Papyrusurkunden*, s. v., Berlin, Selbstverlag der Erben, 1925-27; L. Robert, *Revue de philologie* 17: 111-119, 1943; Taubenschlag, *op. cit.* (note 4), 342-343.

⁹ A few examples will suffice for illustration. In the edict of Germanicus (note 16, below) we read *καταλαμβάνουσαι ξενίας πρὸς βίαν και καταπλήσσεσθαι τοὺς ιδιώτας* (lines 7-9, similarly 12-16), and later *τὰ δὲ . . . ὑποβόγια . . . πρὸς βίαν περιαιρέσθαι κωλύω* (lines 26-28). In their well known petition (Abbott and Johnson, *op. cit.*, No. 139) the villagers of Scaptopara in Thrace complain *ἀναγκάζουσιν ἡμὰς ξενίας αὐτοῖς παρέχειν* (lines 34-35), and *καταπειλοῦσιν παρέχειν αὐτοῖς τὰς ξενίας και τὰ ἐπιτήδεια* (lines 40-42, simi-

ἀρπάζοντων). To read this as referring to their treatment of their hosts-by-compulsion requires making *ὡς ὑποκείμενα . . . εἶναι* (lines 19–20) dependent on ἀρπάζοντων. But it is surely the more natural construction, *ceteris paribus*, for this member of the sentence to depend on the main verb, ἀναλίσκεται—and it will be further demonstrated below that this must in fact be the case. Under this construction it is because they *spend* money, not because they wrest it, that the traveling officials are called “plunderers.” The moneys that best suit such a context are state funds.

The same sense, in somewhat more general terms, is conveyed by the preceding clause of the same sentence (lines 15–17). The formal parallelism of the two clauses is announced by their opening words, “even formerly—and now too” (καὶ πάλαι μὲν—καὶ νῦν δέ). Even before the present instance, says the first clause, the Prefect had heard of “certain expenditures . . . being made by [officials] . . . abusing their powers” (τινας δαπάνας . . . ὑπὸ τῶν . . . ταῖς ἐξουσίαις ἀποχρωμένων γίνεσθαι). The ἀρπάζοντων of the second clause is matched here by the equally pejorative ἀποχρωμένων. And here too the abuse of official position lies clearly not in extorting money, but in *spending* it.

2. No context of extortion is created by πράττω in lines 26–27 or by the subsequent repetitions of that verb. In the first place, πράττω and its derivatives and compounds¹⁰ are part of the regular terminology of the collection of debts, taxes, etc., through lawful channels and by lawful agencies. In the final sentence, to be sure, these collections are specifically characterized as fraudulent and illegal (παράλογως, line 33; παρά τὸ δίκαιον, lines 36–37). But nowhere in this language is there even a suggestion of violence, intimidation, or compulsion. Accordingly, the context that emerges is not one of abusive exaction from hapless and defenseless victims, but one of fraud and illegality practised in the course of lawful collection procedures. We are dealing, in other words, with the language of embezzlement and malversation, not the language of extortion.

A second look at lines 28–33, moreover, particularly 76–84). A recent addition to the texts on this subject is an inscription found in 1952 and published in that year by L. Robert, *Comptes-Rendus de l'Académie des Inscriptions et Belles-Lettres*, 592–596.

¹⁰ With the notable exception of παραπράττω, where the connotation of illegality is in the prefix; cf. note 8, above.

vides corroboration for this inference. Three times in succession the Prefect expressly reiterates that the illegal collections with which he is concerned involve public moneys (εἰσπράξι δημοσίᾳ, ἔπραξεν τὸν νομόν, δαπανᾶται ἐκ τοῦ νομοῦ . . . ἢ πέπρακται), and where he does not say so in so many words the context makes it clear.¹¹

3. παραλογίας (lines 15–16). Here indeed is extortion, if the word intended is παραλογία. Just as παραγράφω means “to make false entries,” and παραπράττω, “to make illegal exactions” (cf. note 10), so παραλογίω and its noun παραλογία designate wrongful collections.¹² If such were Capito's meaning, it would be necessary, I imagine, to regard δαπάνας ἀδίκους as applying to the portion of the edict here under discussion (lines 15–37) and παραλογίας as referring to the illegalities condemned in the subsequent, mutilated portion of the inscription (lines 38 ff.).

There is, however, a much more satisfactory solution. Oliver is unquestionably right in taking the word before us to be παραλογία,¹³ i.e., the abstract noun of παραλογίζομαι and παράλογος, denoting the opposite (παρά) of correct or honest reckoning (λόγος); it is no accident that the adverb of παράλογος occurs later (line 33) in a parallel context.¹⁴ The picture evoked by this language is one of fraud through juggling of records. This too will find further confirmation below.

Summarizing, the language of the edict considered thus far points to fraud and peculation, delicts quite distinct from extortion.

¹¹ Cf. below, especially note 20. The equivalence of δημοσίᾳ and νομοῖς was noted by Oertel, *op. cit.* (note 4), 93 note 1.

¹² “These action nouns [in -ία] are linked up with adjectives in -ιος and particularly with verbs in -ίω, in whose productivity they share in the Koine.”—Palmer, L. R., *A Grammar of post-Ptolemaic papyri* 1: 52, London, Oxford Univ. Press, 1945. Cf. Jouguet, *loc. cit.* (note 4), and for further examples see s.v. in Hunt, A. S. et al., *The Tebtunis papyri* 3, London, Oxford Univ. Press and Cambridge Univ. Press, 1933–1938, and in Liddell, H. G., R. Scott, and H. S. Jones, *A Greek-English lexicon*, Oxford, Clarendon Press, 1940.

¹³ Evelyn White and Oliver, *op. cit.* (note 2), 10. The interchange of η, ε, and ι is one of the commonest phenomena of post-classical Greek: see, e.g., Maysér, E., *Grammatik der griechischen Papyri aus der Ptolemäerszeit* 1: § 11, Berlin and Leipzig, de Gruyter, 1923.

¹⁴ “The group -ος, -εω, -ία formed a close psychological unity. . . . Verbs in -εω tend to pass to the class in -ίω. A consequence of this confusion was that it became possible to form -ία abstracts from -ίω verbs.”—Palmer, *op. cit.*, 70. Note μερὰ παραλογίας = παράλογος; Liddell, Scott, and Jones, *op. cit.*, s.v.

II. *The Prefect's concern is with the improper expenditure of state funds*

This point has already been touched upon in passing; it will now be examined in detail. The language of the edict is really quite explicit on this point, and renders untenable the common assumption that the expenditures in question are those which the populace was compelled to make.

First of all, as observed above, since these expenditures are specifically stated to be made "for expenses and accommodations for themselves" (lines 19-20, *eis δαπάνας καὶ ξενίας αὐτῶν*), it is clearly the officials who are spending the money. There is nothing anomalous in this situation. Soldiers and civilians traveling on official business were indeed entitled to requisition provisions and transportation facilities en route, but they were supposed to pay for these things, at least under the early Principate.¹⁵ Two edicts issued some years before Capito's state this explicitly. The first, issued by Germanicus Caesar when visiting Egypt in A.D. 19, provides that "for boats or animals which we requisition for transport I order that hire be paid according to my schedule."¹⁶ The second even shows close affinity of language to Capito's edict, which it antedates by six years; in it the Prefect Lucius Aemilius Rectus orders that "soldiers, police, and civilian officials in the public services . . . holding a permit from me shall be entitled to take sufficient supplies upon payment of the price therefor."¹⁷ These pay-

ments, then, are the expenditures with which Capito's edict deals.

The next question is: Where did this money for travel expenses come from? The traditional preconception of forced exactions from the populace has obscured the fact that the edict is explicit on this point too. The evidence lies in the word *ὑποκείμενα* (lines 19, 26), which is the technical term for the proceeds of taxes earmarked for emoluments of office.¹⁸ The *ὑποκείμενα* of traveling officials are thus their travel allowances, the sums of money allotted them *out of public funds* for the expenditures which they are authorized to make.¹⁹ The abuse against which Capito's edict is directed is the expenditure of such funds for purposes for which there "are not and ought not to be" (line 20) any allowances. The permit issued by the Prefect's office, Capito emphasizes (lines 25-27), entitles the holder only to have a roof over his head at halts, and to draw from state funds²⁰ the *ὑποκείμενα* authorized by the Prefect Marcus Magius Maximus back in the reign of Augustus.

This view is further confirmed by the penalty clause that follows (lines 27-30). It is this clause, in fact, which constitutes the crucial obstacle to the traditional view that Capito's edict is concerned with forced payments to officials. For under that interpretation of the edict, *εἰν ὅτι τις δῶν* perforce refers to the person paying the money to the grasping official. The whole clause then presents the anomaly of punishing the unhappy victim of illegal treatment!²¹

Grundzüge und Chrestomathie der Papyruskunde 1 (2), Leipzig and Berlin, 1912.

¹⁵ It is important to remember that Capito's edict deals with the routine journeys (for inspections, dispatches, etc.) of minor and medium-grade functionaries, and not to confuse these on the one hand with the circuits of provincial governors, for which the places visited were obliged to cater at their own expense, or on the other hand with mass movements of troops, which entailed extraordinary measures for provisioning. At most these functionaries may have been entitled to lodgings free—this is a possible, though by no means inescapable, inference to be drawn from *ἐτέροις μόνον δέχεσθαι* in lines 25-26 and the distribution of billets mentioned in lines 17-18 of Germanicus' edict (below, note 16); but there is no question here of "Gratistleistungen" (Oertel, *op. cit.*, 92-93) or of "free transportation" (Scramuzza, *loc. cit.* [note 6]). On the requisitioning of means of transport (*ἀγγαρεία*), see Ros-towzew, M., *Angariae*, *Klio* 6: 249-258, 1906, and Oertel, *op. cit.*, 88-90.

¹⁶ The text of the edict is reprinted, with English translation, as No. 211 in Hunt, A. S., and C. C. Edgar, *Select papyri* 2, London, Heinemann, 1934 (*Loeb Classical Library*); the quotation is from lines 18-21.

¹⁷ British Museum Papyrus (P. Lond.) 1171 verso (c), reprinted as No. 439 in Mitteis, L., and U. Wilcken,

¹⁸ Cf. Liddell, Scott, and Jones, *op. cit.*, s.v. *ὑπόκειμα*, II.7.b; also Preisigke, *op. cit.* (note 8), s.v., 4 (the Capito edict is incorrectly listed and interpreted under 3). This substantive sense of *ὑποκείμενα* was established by Martin, *loc. cit.* (note 4); cf. Wilcken, *op. cit.* 1 (1): 37, 215, 375; Wallace, S. L., *Taxation in Egypt*, 333, Princeton, Princeton Univ. Press, 1938; Wolfe, E. R., *Trans. Amer. Philol. Assn.* 83: 98, 1952. Wrongly rejecting Martin's demonstration, Oertel, *op. cit.*, 92, notes 1 and 5, takes *ἰσθδία* in Aemilius Rectus' edict (above, note 17) as travel money and *ὑποκείμενα* in Capito's edict as supplies; but just the reverse is true—*ἰσθδία* are here what the traveling officials paid for, *ὑποκείμενα* what they paid with.

¹⁹ In this the Romans probably adopted or adapted a practice of the preceding Ptolemaic administration: cf. Wilcken, *op. cit.* 1 (2): 488, and *Griechische Ostraka*, 389-390; Oertel, *op. cit.*, 25; and the evidence cited in Preisigke and in Liddell, Scott, and Jones, *loc. cit.*

²⁰ Here as in the following sentences of the edict, *ἐκ τῶν* is thus seen to refer consistently to collection or drawing of state funds; cf. the discussion of this term above.

²¹ This "obscurity" has troubled a number of commentators. Oertel, *op. cit.*, 93, note 1, thought that *τις* "most

With the recognition that the issue before us is not forced contributions to officials but illegal disbursements by them, the entire difficulty disappears and the penalty clause falls into proper perspective. In this clause the Prefect ordains a tenfold penalty against any soldier or official who: (1a) pays out (*ἐάν τις δῶι*) travel money for an unauthorized purpose, or (b) records such a payment as having been made (*ὡς δεδομένον λογίσσῃται*), and (2) charges it to public expense (*εἰσπράξει δημοσίᾳ*). It remains only to add a word of clarification for (1b). Can this still refer, in line with Johnson's suggestion,²² to the state accountants, making them liable to the tenfold penalty if they enter in the public accounts an unauthorized expenditure made by a traveling soldier or official? This interpretation, plausible perhaps at first sight, encounters a twofold objection. First, it requires that *τις* refer to one type of official as subject of *δῶι* and to another as subject of *λογίσσῃται*. Secondly, it ignores *ὡς* ("as if") before *δεδομένον*. These are modest enough remedies, to be sure, when one is construing a barbarously composed or carelessly copied text. But Capito's edict is neither of these. It is grammatically and stylistically a representative piece of good chancery Greek, and it is inscribed without serious error. Once the edict as a whole is seen in its proper context, all that is required, here as throughout, is a straightforward reading of the text as written. Thus read, the *ἐάν* clause says, "If any [traveling official] pays out [*sc.* public money for an unauthorized purpose] or records as if paid out

likely" referred to the local official in charge of the collection of provisions for traveling functionaries; but the verb *λογίζομαι*, as Wilcken had long before emphasized (*Griechische Ostraka*, 493-494), means "to account," in contradistinction to *λογέω*, "to collect;" cf. notes 12 and 14, above. Jouguet, *loc. cit.* (note 4), 10, read this clause as intended to prevent the victim of extortion from obtaining reimbursement from the state; but he himself found this explanation unsatisfactory and suggested in a final afterthought, "Il s'agit peut-être aussi de fonctionnaires." Johnson, *loc. cit.* (note 4), observing that "lines 27 ff. . . . [seem] to deal with similar exactions from the nome, and not from private citizens," suggested that "illegalities practised by accountants" might be involved.

Scramuzza, *loc. cit.* (note 6)—taking his cue, as far as I can see, from Jouguet, but, if so, reversing Jouguet's idea—thought that the edict actually afforded a means of redress for individuals claiming that they had been subjected to excessive demands (see further note 25, below)! This is compounding the impossible.

²² Cf. above, note 21.

[*sc.* a sum not actually paid],²³ and charges it to public expense." What the Prefect is telling us here—and this will come as no surprise to any modern reader—is that the travel allowance "racket" had reached the point where, in addition to using state money for unauthorized expenditures for their own convenience, the soldiers and civilian functionaries were padding their travel expense accounts by listing fictitious expenses as well. This is in perfect concinnity, moreover, with the opening words of the edict, where—stating his theme, as it were—Capito announces his concern over precisely these two abuses: *δαπάνας ἀδίκους* in line 15 are the actual but unauthorized expenditures of *ἐάν τις δῶι*, and *παραλογίας* there (cf. the discussion above) are the bookkeeping frauds of *ὡς δεδομένον λογίσσῃται*. The same parallelism recurs also in lines 32-33, where *ὅσα δαπανᾷται* refers to money actually spent, and *πέπρακται παραλόγως* to money obtained by fraud.

In order to enforce the penalty clause, the following clause (lines 31-37) establishes a procedure for detecting fraud and peculation. Local clerks are ordered to keep a record of all nome funds "spent or drawn fraudulently or otherwise"; every sixty days—every four months in the Thebaid—these records are to be submitted to the audit offices of the nomes and dispatched to Alexandria for scrutiny by the accountants of the provincial audit bureau, of which one Basilides, an imperial freedman, is in charge;²⁴ and the Prefect promises to take appropriate action when funds are found to have been "collected or obtained illegally."²⁵

²³ A similar occurrence of the verb *λογίζομαι* is found in Aristophanes, *Plutus* 381, where Chremylus remarks, "You'd like to spend three minae and bill me for twelve."

²⁴ The sense of this clause and the position of Basilides were correctly discerned by Wilcken (*op. cit.* [note 17] 1 (1): 208-209, and *Griechische Ostraka*, 502; cf. Dittenberger, *op. cit.* [note 2], 379 note 35); he even correctly conjectured the *τὸν ἐπὶ* which Evelyn White's later examination showed in fact to be on the stone at the end of line 35. From the inception of the Roman administration in Egypt the leading officials of the province were "attended by imperial freedmen and also by procurators who are entrusted with affairs of greater and lesser importance" (Strabo, *Geography* 17.1.2 [C 797]). The Emperor Claudius' increased employment of freedmen to staff the civil service departments, with freedmen of his own household at the heads of the departments, is a well known and significant development in the history of Roman imperial administration: cf., e.g., Charlesworth, M. P., *Cambridge ancient history* 10: 686-690, Cambridge, Cambridge Univ. Press, 1934.

²⁵ Scramuzza's paraphrase of this clause (*loc. cit.* [note 6]), is replete with amazing misinterpretations: the *gram-*

Translated, then, in the light of the foregoing analysis, Capito's edict reads:

Gnaeus Vergilius Capito declares: Even before this I kept hearing that certain unlawful expenditures and frauds were being perpetrated by persons greedily and impudently abusing their powers, and now too I have noted particularly in the lawsuit of the Libyans that persons in the public services are brazenly peculating by making certain disbursements in the guise of allowances—which do not and ought not exist—for their expenses and accommodations, and likewise under the title of transportation requisitions. Wherefore I command that the soldiers, cavalrymen, orderlies, centurions, military tribunes,

mateis "are ordered . . . to redress within sixty days whatever wrongs have been inflicted [!]. An imperial freedman was appointed in every nome [!], and by Claudius himself [!]. . . Dissatisfied claimants could appeal from the freedman's decision to the prefect [!]."

and all others journeying through the nomes shall take nothing and make no transportation requisitions, excepting those who have permits from me; and that even these travelers shall be provided with shelter only, and no one shall draw any allowance beyond those established by Maximus. And if anyone pays out or reports a sum as paid out and charges it to public expense, I will make him pay back ten times the amount which he obtained from the nome, and to the informer I will give a fourfold share from the property of the person convicted. The royal secretaries, the village secretaries, and the district secretaries in a nome shall record all sums expended from nome funds for any purpose or obtained fraudulently or otherwise, shall deliver [these records] every sixty days (the secretaries in the Thebaid every four months) to the audit offices, and shall send them to Basilides—the imperial freedman in charge of the Audit Bureau—and the state accountants, so that if anything has been illegally collected or obtained I will remedy the matter.

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