Chapter 8

THE ECONOMIC SIGNIFICANCE OF NATIONAL EDUCATION[1]

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THE work launched by the State Planning Commission on a ten-year plan for expanding the network of schools of the National Commissariat for Education, with a general view to reconstructing our national economy and with the particular aim of satisfying the needs of the country by improving the degree of skill of the labour force, has again presented us, though in a different guise, with the problem of the more important factors in the degree of skill of labour.

We had often carried out investigations into the statistical relation between these factors and education from 1918 onwards. But our early work was hampered by the insufficient amount of data relating to education and we were obliged to confine ourselves to the most elementary grouping of the material. Because of this, we could only establish the most prominent inter-dependencies between the factors to a first approximation.

Thus, for example, by comparing the degree of skill with age, length of service and education in turns with various groupings, we showed quite clearly that there is a very close relation between all the factors given and the degree of skill at some trade. But we were quite unable to establish the exact nature of this relation since the influence of each factor taken separately was complicated for our groupings by the concealed influence of the other factors, which remained unknown for any given group. If, for example, our trade returns were divided into groups according to increasing educational qualifications, in order to ascertain the corresponding increase in the degree of skill, we started from the assumption of 'other things being equal' with respect to the groups being compared for the degree of skill. However, this assumption was far from being

[1] Translation of article in *Ekonomiki Truda*, 1925, by Barbara Jeffrey. This was one of the first attempts to analyse the economic effects of education. Because of its enduring interest it was included among the papers of the conference.

E. A. G. Robinson et al. (eds.), *The Economics of Education*

universally valid, since groups of workers of different education are usually quite clearly differentiated as to age and length of service as well as a whole lot of other factors, the influence of which on the degree of skill was not even being studied.

Because of this, as soon as we were in a position to incorporate more data into our research, we decided to apply to it methods which make use of as detailed as possible combinations of the groups of the factors being studied.

I. MANUAL LABOUR AND SCHOOL EDUCATION

We had about 50,000 trade returns of Leningrad workers — from cross registration of members of the Metal Workers Trades Unions for 1919 — but we had neither the means nor any particular need to use them all.

By means of preliminary research into the stability of the indices under consideration, we established how much data had to be processed in order to be able to achieve the greatest possible accuracy in the results compatible with the nature of data and the needs of the investigation. When it turned out that it was only necessary to use about 2,000 to 3,000 samples from the trade groups we had chosen, we picked out about 2,600 of the most skilled workers in the returns for machine tool shops, *i.e.* mostly lathe, milling machine, planing machine, mortising machine, drill and other similar machine-tool operators. The degree of skill in our returns was fixed according to wages with a 12-category scale of wages. But the scale and particularly the rates for 1918–19 were not sufficiently good criteria of the degree of skill. The prewar evaluation of labour of different degrees of skill by fairly free competition on the labour market, it seemed, corresponded much more closely to the requirements of such a criterion. However, by comparing these evaluations for various trades just before the war with the wage classes of these trades in 1918–19, we established that, if the prewar evaluation of the degree of skill corresponding to the postwar 1st class is taken as unity, then we obtain an evaluation 2·6 times as great for the 9th class, 3·2 times as great for the 12th and so on. On a basis of these relations, it was not difficult for us to translate wage classes into these prewar evaluations of them. We called the unit of measure for the degree of skill corresponding to the degree of skill of a worker of the first wage class, a 'labour unit' or lu for short.[1]

[1] Conversion from wage class to lu is carried out using the expression $x = 1 + 0{\cdot}2\,(n-1)$ where x is the number of lus and n is the number of the class in the 12-class scale of workers.

TABLE 1

STABILITY OF THE INDICES UNDER CONSIDERATION

Groups of Machine Tool Operators		Mean Values				Deviation from the Mean in %			
		Age	Education	Length of Service	Skill				
		In Years			In lu				
No. (1)	Number of Samples (2)	(3)	(4)	(5)	(6)	Age (7)	Education (8)	Length of Service (9)	Skill (10)
1	326	30·92	2·54	13·80	2·45	−5·2	+6·3	−7·6	+0·4
2	325	33·17	2·38	16·62	2·42	+1·8	−0·4	+11·3	−0·8
3	325	32·06	2·31	15·14	2·43	−1·7	−3·3	+1·4	−0·4
4	325	32·34	2·51	14·39	2·47	−0·8	+5·0	−3·6	+1·2
5	325	34·11	2·21	15·49	2·49	+4·6	−7·5	+3·8	+2·0
6	326	33·45	2·41	15·27	2·50	+2·6	+0·8	+2·3	+2·5
7	325	31·75	2·36	14·05	2·32	−2·6	−1·3	−5·9	−4·9
8	35	32·99	2·42	14·65	2·44	+1·2	+1·3	−1·9	0·0
1-2	651	32·05	2·46	15·21	2·43	−1·7	+2·9	+1·9	−0·4
3-4	650	32·20	2·41	14·76	2·45	−1·2	+0·8	−1·1	+0·4
5-6	651	33·78	2·31	15·38	2·50	+3·6	−3·3	+3·0	+2·5
7-8	650	32·37	2·39	14·35	2·38	−0·7	−0·0	−3·9	−2·5
1-4	1,301	32·12	2·44	14·99	2·44	−1·47	+1·84	+0·40	0·0
5-8	1,301	33·08	2·35	14·87	2·44	+1·47	−1·84	−0·40	0·0
1-8	2,602	32·60	2·39	14·93	2·44	0·0	0·0	0·0	0·0

In order to determine the stability of the indices which we intended to use and the probable mean error for different numbers of samples, we used the following device:

We divided each of the 2,602 cards for the machine-tool operators that we had chosen into two groups of 1,301 by simply mechanically distributing one card to the left and one to the right. Each of these groups was then divided again into two, and each of the resulting groups once again into two. We then had 8 groups in all. Then the mean age (in years), the educational qualifications, the length of service in a trade (in years) and degree of skill were all calculated separately for each group. The results of these calculations were as follows (see Table 1).

It is clear that groups of 325 workers after simple mechanical division already give a very stable indication of the mean length of service, educational qualification, age and wage class of a group. The maximum range of deviation from the mean does not exceed 11·3 per cent for length of service, 7·5 per cent for educational qualifications, 5·2 per cent for age and 4·9 per cent for skill. When the groups are increased to 650, these deviations are much smaller, for 1,300 they are not greater than 1·5-2 per cent.

The mean deviation for those groups themselves is of course even smaller. Taking simple arithmetic means of these deviations, we find:

No.	Size of Group according to Number of Samples	Mean Deviation in %			
		Length	Education	Age	Skill
1	325/6	3·9	3·2	2·6	1·5
2	650/1	2·5	1·8	1·8	1·4
3	1,301	0·4	1·8	1·5	0·0

It is known from the theory of probability that the mean error in the mean value found when using parts of the whole volume of data as well as the whole volume used in the investigation, decreases or increases inversely proportional to the fourth root of the number of samples used. Using this relation, and assuming the coefficients of error for groups of 325 cards given above, it can be shown that the accuracy of the mean values for the indices under consideration as a function of the size of the group is given by:

Size of Group	Probable Error in % for			
	Length	Education	Age	Skill
10	23·1	18·0	14·8	8·5
20	16·4	12·7	10·5	6·0
50	10·0	8·0	6·7	3·8
100	7·0	5·7	4·7	2·7
200	5·0	4·0	3·3	1·9
500	3·1	2·5	2·1	1·2
1,000	2·2	1·8	1·5	0·9
10,000	0·7	0·6	0·5	0·3

The possible error in filling up the trade cards was not more than 1 year in age, 0·5 years in education and length of service and 1 class or 0·2 lu in degree of skill. As percentages of the mean value for all 2,602 machine-tool operators, this possible error is 3 per cent for age, 3·3 per cent for length of service, 8 per cent for degree of skill and 20·5 per cent for educational qualifications. To strive to achieve a greater degree of accuracy than that for the primary samples would of course be a great waste of effort. For this reason, there was no point in making the groups of cards any larger than 300-400 in order to achieve the aim we had set for ourselves.

However, as the calculations showed, the required degree of conformity often appeared even with significantly smaller groups of the material.

According to our plan, the basic groups should show the variation in the mean degree of skill as a function of all three factors under consideration — age, length of service and education. For this purpose, the material was first divided into age-groups (8 groups) and then within each of these groups, into sub-groups according to the length of service in a trade (13 groups) and then again into sub-groups according to educational qualifications (11 groups); only then was the mean degree of skill calculated for each of these last sub-groups (in lu). But such detailed groups would have given us not more than 2-3 cards per group even for 2,602 cards. For this reason, they were directly converted into three tables of sum totals, each of which combined only two of the factors and in turn omitted the third factor.

All the comparatively complicated work in marking out and calculating the material in accordance with the methods proposed by me, was very carefully carried out by Professor B. N. Babiny, and a large part of it has already been published by him.[1] Therefore

[1] See *Handbook of Statistics*, Vol. XV, No. 12, 1923, pp. 103-23.

TABLE 2

DEGREE OF SKILL AS A FUNCTION OF AGE AND LENGTH OF SERVICE

(In lu)

Groups by Age (1)	Groups by Length of Service (in Years)							For all Groups			
										Degree of Skill	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	No. of Samples (9)	Service (in Years) (10)	Mean (11)	Normalized with Service 4·3 Years (12)
13-19	0·94	0·96	1·09	1·37	1·49	1·78	2·26	470	3·2	1·37	1·58
20-24	(1·73)	(1·67)	(1·50)	1·93	1·97	2·17	2·39	186	5·3	2·16	2·00
25-29	(2·67)	(1·07)	(1·71)	2·07	2·26	2·33	2·55	142	5·7	2·34	2·18
30-34	(2·10)	(1·40)	(2·05)	2·14	2·48	2·24	2·42	92	5·3	2·29	2·21
35-39	(2·16)	(1·84)	(2·40)	(1·93)	(1·91)	(2·35)	2·45	50	4·3	2·16	2·19
40-44	(1·80)	(2·00)	(1·52)	(1·80)	1·88	(2·20)	(2·18)	39	4·0	1·92	1·97
All groups :											
No. of samples	56	73	115	147	160	229	199	979	4·3	—	—
Mean age	22	21	20	21	23	23	26	—	—	—	—
Mean degree of skill	1·31	1·12	1·22	1·59	1·79	2·08	2·42	—	—	1·81	—
Normalized degree of skill at an age of 23 years	1·55	1·24	1·43	1·70	1·82	2·02	2·35	—	—	—	—

we confine ourselves here to that which is necessary to explain the methodology of the work and the final results.

Our task was to isolate the influence on the degree of skill exerted by each of the factors under consideration taken separately by excluding the effects due to the other factors. In order to clarify the way in which this was done, we first introduce the following table (see Table 2).

In this table we omitted some workers in the higher age-groups, and some of those with greater lengths of service, since a combination of high age with short length of service or long length of service and low age occurs extremely rarely and is therefore of very little significance. But, even within the age limits that are included in the table, we find a whole series of very small groups. These groups with a number of samples less than 10 are given in brackets.

We have already seen above, that the theoretical accuracy of the mean values for such small numbers of samples is less than 15-20 per cent of the calculated value, and therefore the regular increase or decrease in the coefficients of the degree of skill in separate vertical or horizontal lines of the table can be shown accurately only in those cases where the difference between adjacent coefficients is greater than this percentage.

However, this is not so, and therefore separate lines do not give entirely distinct regularities. They appear much more prominently in the totals where the number of samples rises to an average of 140-60, and the probable error falls to 5-6 per cent. Here the difference between adjacent coefficients of the degree of skill exceeds 5-6 per cent in all cases, and therefore we had no good reason to suppose that the regularity found was only coincidence. In general there is regularity in that the degree of skill increases with increase in the length of service, whilst, with increase in age, it rises at first up to 30-34 years and then, having reached its maximum value, it falls again. The only deviations from this general rule are found in one group with a length of service of less than one year, which gives a degree of skill higher than the following group with a longer length of service. But, the number of samples in this group is very small and also the mean age is higher than in the following groups, so it is possible that other concealed factors, such as, for example, a high educational qualification, would give a more exact explanation of the deviation if we could investigate them all.

In order to exclude the influence of different ages in the different groups divided according to length of service, we introduce the device which is familiar under the name of 'normalization' or standardization of the means. It is very often used when calculating

TABLE 3

AGE AND DEGREE OF SKILL FOR MACHINE TOOL OPERATORS

Groups by Age (in Years)	Number of Samples	Empirical Mean				Normalization of Degree of Skill (in lu)			Smoothed Degree of Skill	
		Age (t)	Service (s)	Education (e)	Degree of Skill (in lu)	Length of Service, 11·1 Years (K_1)	Education, 2·4 Years (K_2)	Length of Service 11·1 Years and Education, 2·4 (K_3)	In lu	In % Maximum
		In Years								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
13-19	470	17	3·2	2·5	1·37	2·22	1·37	2·22	2·22	88·2
20-24	238	22	7·1	2·8	2·27	2·44	2·21	2·38	2·38	94·5
25-29	361	27	10·5	2·8	2·64	2·55	2·58	2·49	2·49	98·8
30-34	390	32	14·4	2·5	2·72	2·53	2·71	2·52	2·52	100·0
35-39	405	37	19·0	2·4	2·80	2·52	2·79	2·51	2·51	99·8
40-44	336	42	21·8	2·1	2·80	2·37	2·83	2·40	2·48	98·5
45-49	222	47	24·8	1·9	2·74	2·37	2·79	2·42	2·42	96·1
50-77	180	55	30·5	1·8	2·73	2·19	2·76	2·22	2·22	88·2
13-77	2,602	32·6	14·8	2·39	2·45	—	—	—	—	—

the mean death rate for various trade or social groups. It consists in the groups under investigation being reduced to a comparable age structure. In our case, we start from the assumption that all our groups for different lengths of service are divided into sub-groups according to age in the same ratio as their totals shown in Column (9), which corresponds to the mean age of 23 years. Such arithmetic 'normalization of the degree of skill' for a mean age of 23 years is achieved by means of the successive multiplication of the coefficients of the degree of skill in each vertical column by the corresponding number of samples in Column (9) after the sum of these products for each column is divided by the overall total of samples in Column (9), *i.e.* by 979.

Similarly, the age normalization in Column (12) for a mean length of service of 4·3 years is found by excluding the influence of different lengths of service on the degree of skill of the various age-groups being compared.

By using this method of normalization for all the material in our tables with occasional necessary interpolations, we found the following results for the age factor in the degree of skill (see Table 3).

Due to the fact that groups with long lengths of service have been included, the mean coefficients of the degree of skill in this table turn out to be somewhat greater than in Table 2. But the general nature of the patterns is the same.

The means of finding the coefficients given in the Columns (3-6) do not require any explanation. The method of calculating the normalization of the degree of skill with either the length of service or the educational qualifications — Columns (7) and (8) — was given above. But in Column (9) we have gone one stage further. Here we are trying to exclude two factors at once by combining the length of service and educational qualifications, so that in this way we can obtain some picture of how the degree of skill varies as a function of age alone.

How is this done ? We have already established for each age the size of the correction to the empirical degree of skill (K) necessary in order to find the degree of skill with 'all other conditions being equal', corresponding to any given length of service (K_1) or educational qualification (K_2), so the matter is quite simple. In order to transform the empirical length of service (s) to the given 11·1 years — 'for all other conditions being equal' — it is sufficient to make the correction $K_1 - K$ to the empirical value for the degree of skill. Similarly, in order to transform the empirical educational qualification (e) to that given of 2·4 years all that is necessary is to make a correction of $K_2 - K$. Then, in order to transform the empirical

length of service and educational qualification simultaneously to the given values — for 'all other circumstances being equal' — it is sufficient to add the sum of both corrections to the empirical value K, and then the required K is given by the expression

$$K_3 = K + (K_1 - K) + (K_2 - K) = K_1 + K_2 - K.$$

This is exactly how Column (9) is obtained. Of course, the prerequisite emphasized above — 'all other things being equal' — is not entirely satisfied by the method described for the normalization. Firstly, in order to use it we were obliged to omit completely some of the groups which were very small, and secondly, using the method of weighting to the mean number of samples for all groups, we changed the specific gravity in each line and in each of its members not only for those coefficients which we consciously wished to reduce to the known mean standard, such as the length of service and mean age in Table 2, but also those which remain unknown in this table, such as the educational qualifications. However, the checks on the resultant deviations showed us that they were not very significant. Thus in Table 3, where it was necessary to omit the largest number of samples in order to carry out the normalization, that is to say 499 out of 2,602,[1] the mean educational qualification was 2·39 for 2,602 cards and rose to 2·44 when the 499 cards were omitted, but then returned to 2·4 years after normalization. Deviations of this magnitude are not significant with our accuracy of the original primary samples. It is true that, for separate age-groups, these deviations probably reached more significant values, but in general our method obviously gives the required conformity with sufficient accuracy even despite its defects.

The series of coefficients given in Column (9) of Table 3 represent a very smooth curve when plotted as a graph except for the ages 40-44 years. Comparing this series with the graph, we get 2·48 lu for the given age instead of 2·4 years. This correction is 3·3 per cent of the calculated value. Theoretically, the mean probable error for this group of 336 samples should only be 1·5 per cent. But if we remember that the possible error in the primary sources of the degree of skill was about 8 per cent, then the probability of random deviations of separate members of the series of 3 per cent does not seem very excessive, and the smoothed series may entirely be taken as entirely representative of the characteristics of the required relation.

It tells us that, if we exclude the influence of education in school

[1] It was necessary to omit all groups with long service, since it is not possible for young people to have a long service and *all* age-groups are necessary for normalization.

and in the trade, then the influence of age on the degree of skill, or the quality of manual labour, can be characterized in the following way: Up to 32 years, *i.e.* up to the full development of the physical strength of the worker, his degree of skill increases continuously, thereafter it naturally begins to decline with increasing age and failing strength, and the market value of the degree of skill of the ageing worker falls.

Since it agrees with our everyday experience, this conclusion might be thought too trivial, if it did not give a numerical measure of the phenomena under investigation. Even without statistics, we knew a great deal about declining strength in old age, but we should not have known that old age is reflected in our work from the age of 32 onwards if it had not been for this investigation. Even less should we have known exactly the nature of the rise and fall in the work capacity at various ages.

The influence of the length of service in a trade on the degree of skill is found in exactly the same way in the following table (see Table 4).

From this table it can be seen that the degree of skill increases throughout the whole length of service, unlike the alteration with age. It is true that, for the first few years of service, the degree of skill increases more quickly than in the later years, but all the same it grows as the length of service increases. This time, when the calculated coefficients are compared with the smooth curve, the two hardly differ at all except for the very extreme members of a series. But here too, even for the groups with the smallest number of samples (60 cards), the magnitude of the deviations is not greater than the possible error in the original samples. On average, the deviation is not greater than 0·8 per cent for all points in both series.

Naturally the length of service appears to be a much more active factor in the degree of skill than does age. Whilst a whole ten years' difference in age cannot alter the mean degree of skill of any group of workers by more than 12 per cent, the variations in the degree of skill as a result of the length of service can be measured in hundreds of per cent. Even during the years of sharpest increase in degree of skill — from 17 to 22 years — it only rises 0·04 lu in all for an increase in age of one year, whilst during the first few years of service, it has a yearly increase of 0·15 lu, *i.e.* it increases 3-4 times more quickly.

As in Table 3, Column (9) here is calculated for the expression $K_3 = K_1 + K_2 - K$. The coefficients given in brackets in Columns (7) and (8) are found from the corresponding coefficients in Column (6) by means of direct addition of the corrections for the difference

TABLE 4

LENGTH OF SERVICE AND DEGREE OF SKILL

Groups by Length of Service in Years	No. of Samples	Actual Averages				Normalized Degree of Skill for (in lu)			Smoothed Degree of Skill	
		Length of Service	Age	Education	Degree of Skill (in lu)	Age 29·6 Years	Education 2·4 Years	Age 29·6 Years. Education 2·4 Years	In lu	In % Minimum
		In Years								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0-1	60	0·5	23·8	2·1	1·40	(1·48)	1·43	1·51	1·37	100
1-2	76	1·5	21·7	2·4	1·15	1·51	1·17	1·53	1·53	112
2-3	116	2·5	20·1	2·1	1·22	1·68	1·24	1·70	1·68	123
3-4	149	3·5	21·5	2·4	1·60	1·87	1·62	1·89	1·82	133
4-5	160	4·5	23·2	2·3	1·79	1·97	1·77	1·95	1·95	142
5-7	233	6·0	23·8	2·3	2·08	2·11	2·08	2·11	2·11	154
7-10	206	8·5	26·7	2·8	2·41	2·35	2·36	2·30	2·32	170
10-15	355	12·5	30·7	2·6	2·70	2·62	2·69	2·61	2·62	190
15-20	357	17·5	34·6	2·5	2·84	2·82	2·82	2·80	2·80	204
20-25	391	22·5	39·5	2·3	2·88	2·89	2·89	2·90	2·90	212
25-30	268	27·5	42·5	2·2	2·90	(2·94)	(2·93)	2·97	2·99	218
30-35	137	32·5	46·8	2·3	2·95	(3·07)	(2·97)	3·09	3·08	225
35 and over	94	(40)	53·4	2·1	2·91	(3·19)	(2·96)	3·24	3·22	235
0-35 and over	2,602	14·8	32·6	2·39	2·45	—	—	—	—	—

in age (29·6 yr. $-t$) or education (2·4 yr. $-e$) calculated according to Tables 3 and 5.

The influence of educational qualifications on the degree of skill (shown in Table 5) is found on the basis of the data from the same calculations.

It was the most difficult task of all to express the educational qualifications of the workers exactly in the number of years spent at school. We grouped the material according to the type of school attended, *i.e.* two-year, three-year and so on. Those who did not finish two-year school, we reckoned as having an educational qualification of 1-2 years and we of course included in this group all those workers who were literate without ever having attended any school at all. But obviously self-education by the workers corresponds to a higher educational qualification than a year or a year and a half at school as a child. In any case, if the influence of educational qualifications is smoothed off to fit a curve in such a way that the sum of the deviations of the empirical points given in Column (9) from the smooth curve (Column (10)) is equal to zero, then the degree of skill corresponding to 1 to 2 years of education has to be considerably lowered. Nevertheless, even here the mean size of the deviation of the points from the smoothed curve is not greater than 0·05 lu or 2 per cent deviation from the calculated mean degree of skill. This error is much lower than the error in the original samples.

There were so few workers with an education of 6 or 7 years or more that we were unable to include these groups in the calculation of the normalized degree of skill by the method given above. For this reason the coefficients of the degree of skill for these groups, given in brackets (in Columns (7) and (8)), are calculated directly by means of the correction to Column (6) according to the data of Tables 3 and 4.

It can be seen that the workers spent very few years in school. But even these 2-3 years increase their degree of skill by tens of per cent. Using the smoothed series for the interdependencies between the degree of skill (K), age (t), length of service (s) and school education (e) given in Tables 3, 4 and 5, it is not difficult to express some functional relation between them by an algebraic expression. At our request, the well-known mathematician L. K. Laktin produced the following simple quadratic equation which expresses the required functional relation between the given quantities very closely :

$$K = 2{\cdot}53648 - 0{\cdot}002719(t - 37) - 0{\cdot}0008644(t - 37)^2 + 0{\cdot}1247(e - 2{\cdot}36) + 0{\cdot}04937(s - 11{\cdot}06).$$

According to this expression, a worker of 17 years of age without

TABLE 5

EDUCATIONAL QUALIFICATIONS AND DEGREE OF SKILL

Groups by Education (in Years)	Number of Samples	Original Data				Normalized Degree of Skill (in lu) for			Smoothed Degree of Skill	
		Education	Age	Service	Degree of Skill	Age 32·7 Years	Service 14·8 Years	Age 32·7 Years Service 14·8 Years	In lu	In % Minimum
		In Years								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0	72	0	43·7	17·3	2·27	1·88	2·23	1·84	1·84	100
1-2	840	1·5	34·4	15·4	2·43	2·39	2·42	2·38	2·28	124
2	531	2	31·3	13·7	2·36	2·39	2·40	2·43	2·37	129
3	632	3	31·8	15·1	2·48	2·47	2·47	2·46	2·52	137
4	317	4	30·1	14·4	2·47	2·58	2·48	2·59	2·63	143
5	146	5	30·0	14·6	2·66	2·67	2·61	2·62	2·73	148
6	44	6	30·3	14·0	2·81	(2·82)	(2·84)	2·85	2·80	152
7-12	20	8	26·8	11·0	2·66	(2·69)	(2·85)	2·88	2·88	157
0-12	2602	2·39	32·6	14·8	2·45	—	—	—	—	—

any service at all has a degree of skill of 1·43 lu (3rd wage group), and a worker of 55 years of age with the highest education (13 years) and a length of service of 32 years has a degree of skill of 4·58 lu, which corresponds to the 24th wage class on the 35 wage-scale or 13-14th on the 17-class scale. However, Professor Laktin's expression somewhat oversimplifies the dependency of the degree of skill on the length of service and educational qualifications. It noticeably increases the significance of K at very short or very long lengths of service and education, and only gives a sufficiently accurate value for K for central values of K and e.

It is very interesting to compare the effectiveness, in terms of increasing the degree of skill, of school education and training in a factory during work. The additional degree of skill due to education and the first years of service can be found in Tables 4 and 5 (see table on next page).

If we only consider the total coefficients, then we are forced to conclude that one year of school education gives rise to an addition to the degree of skill that is 2·6 times greater than that due to a year of training in a factory. But the mean coefficients are not very significant in this case. However, if we take into account the annual index for the increase in the degree of skill, then we must conclude that only the first three years at school definitely give the worker more than the same amount of time spent training in the factory. However, it would be a great mistake to conclude from this that, for manual labourers, three years of school is sufficient. Most of all it would be a mistake because school education and factory training are not mutually exclusive but are complementary to one another since, under our laws, the minimum age for starting work is 16 and that for starting school is 8. It is possible that everything taught to a worker from 8 to 16 would be pure profit for him in his career.

But the question is much wider than this.

We are interested not only in the gain for an individual who receives education at the expense of the state, but also in the question of the cheapest and most effective way of creating a productive labour force. Any amount of education may be extremely desirable and useful for an individual worker if it is free. But the state which has to pay for this education wants to know whether all amounts of education are equally useful in raising the country's productivity. If all amounts are not equally useful, what is the most profitable length of education for each worker, and how much should be spent on it in order to spend the national revenue in the way most likely to increase it in the future ?

MEAN INCREASE IN THE DEGREE OF SKILL
(In lu)

Year	Annual Increase	
	Service	Education
1st	0·16	0·30
2nd	0·15	0·23
3rd	0·14	0·15
4th	0·13	0·11
5th-7th	0·11	0·08
7th-9th	0·08	0·04
0-9	0·12	0·12
10-19	0·04	—
20-29	0·02	—
30-40	0·018	—
0-40	0·046	0·12

Such a purely economic approach to the problem does not of course exclude the political and other evaluations of its significance. If, for example, it should be shown that the most profitable thing for the economy was not to spend a farthing on education for the workers and to exploit their labour from the age of 8 years onwards in the factories and works, as it was in 'the good old days', then we should have had to work out exactly for whom this was the most 'profitable'. We should scarcely be tempted in this way by profits. However, there is all the more reason not to remain without some reckoning of the economic aspect of the matter of national education since the nation is not threatened by any regression from this point of view. In order to make a rational estimate of the optimum length of school education it is necessary to determine what each year at school gives the worker and what it gives the state and what it costs to the worker's family and the state as a whole. The profits corresponding to each year at school as expressed by the corresponding rise in the degree of skill are calculated in Table 6.

Here we start from the assumption that the period of school education finishes at 16 years. From this age onwards the worker starts to serve in his trade. The mean work capacity of such a worker reaching 16 years of age was determined by us from the tables of mortality and illness of Marshelevsky for 37 years. Using Tables 3-5 to determine the mean increase in the degree of skill for every age and year of service and education, and having determined

from Table 4 the degree of skill of a worker with a length of service of 26·5 years, an age of 42 years and an educational qualification of two years — as 2·86 lu — for which it was necessary to make a

TABLE 6

DYNAMICS OF THE DEGREE OF SKILL FOR MACHINE-TOOL OPERATORS (1919)

Age	Service	Increase in Degree of Skill	Degree of Skill (in lu) for Education (in Years)							
In Years			0	1	2	3	4	5	6	7
16	0·5	—	0·43	0·73	0·96	1·11	1·22	1·31	1·38	1·46
17	1·5	0·20	0·63	0·93	1·16	1·31	1·42	1·51	1·58	1·66
18	2·5	0·19	0·82	1·12	1·35	1·50	1·61	1·70	1·77	1·85
19	3·5	0·17	0·99	1·29	1·52	1·67	1·78	1·87	1·94	2·02
20	4·5	0·16	1·15	1·45	1·68	1·83	1·94	2·03	2·10	2·18
21	5·5	0·15	1·30	1·60	1·83	1·98	2·09	2·18	2·25	2·33
22	6·5	0·14	1·44	1·74	1·97	2·12	2·23	2·32	2·39	2·47
27	11·5	0·50	1·94	2·24	2·47	2·62	2·73	2·82	2·89	2·97
32	16·5	0·23	2·17	2·47	2·70	2·85	2·96	3·05	3·12	3·20
37	21·5	0·10	2·27	2·57	2·80	2·95	3·06	3·15	3·22	3·30
42	26·5	0·06	2·33	2·63	2·86	3·01	3·12	3·21	3·28	3·36
47	31·5	0·03	2·36	2·66	2·89	3·04	3·15	3·24	3·31	3·39
52	36·5	0·01	2·35	2·65	2·88	3·03	3·14	3·23	3·30	3·38
16-53	18·5	—	2·00	2·30	2·53	2·68	2·79	2·88	2·95	3·03
Variation in %		—	100	115	126·5	134	139·5	144	147·5	151·5
Increase in Degree of skill		—	—	0·30	0·23	0·15	0·11	0·09	0·07	0·08

correction to the given tables of 0·04 lu, we easily found all the remaining coefficients in Table 6.

But what exactly do they tell us ?

The mean degree of skill for an illiterate worker over his whole working life is given as 2 lu, which corresponds to the 6th wage class of the old scale or a wage coefficient of 2·0. From the general accounts from April to June 1924, it appears that the wage scale for the first class of factory workers consisted on average of 11·75 roubles a month or 141 roubles per annum. On the basis of this, our unskilled worker earns in his whole life (37 years) $37 \times 2 \times 141 = 10{,}434$ roubles. A worker with one year of education earns 15 per per cent or 1,565 roubles more. This then is the value of the first year of school from the point of view of the income of the worker's family. The second year at school is already less valuable — 1,200

roubles in all; the third — 782, the fourth — 574, the fifth — 470, the sixth — 365 and the seventh and eighth even less — about 208 roubles between them.

This is the economic significance of school education to the worker himself. But it is incomparably greater in the national budget. The fact is that the worker not only entirely pays for his wages by the product of his labour, but he also creates this product for society. The additional products which increase as the productivity of the labour and the degree of skill of the workers increase, at the very least before the revolution made up not less than 100 per cent of the wages.[1] The significance of education to the budget of the country may be to about double the revenue.

Now let us see what we spend on every year of education.

According to the figures given in the State Plan, the annual expense in Russia of an entire primary school with 40 children is made up in the following way:

Items of Expenditure	In 1913		In 1924/25*	
	Prewar Roubles	per cent	Old Roubles	per cent
1. Economic operations	263·60	31·7	199·00	24·9
2. School expenses	115·00	13·8	147·00	18·4
3. Writing materials	33·70	4·0	54·20	6·8
4. Teachers' stipends	420·00	50·5	399·60	49·9
Total	832·30	100·0	799·80	100·0

* Taking into account the rise in wages for teachers to 30 roubles per month.

This comes to not more than 20-25 roubles per annum per head.

The expenditure for the last few years, particularly taking into account the fall in the purchasing power of gold after the war, is incomparably lower than the norm before the war. But we raise them here to the estimated figure of 800 roubles, having in mind the present intended increase in the wages of teachers to 30 roubles

[1] The relation between wages and production can be assessed from the figures given below for the production in the main industries of Russia in 1913. The total gross production within the Union up to 1939 was determined as 5,621 million roubles. If we subtract from this the value of raw materials and fuel (2,963·5 mil.r.), the repair of equipment and buildings (281·0 mil.r.), depreciation (250·9 m.r.) and insurance (168·6 m.r.), then the remainder of pure product is 1·957 million roubles. The wages of workers and office staff, including all expenditure on maintenance of the workers (62·8 m.r.) and gratuities for the office staff (43·5 m.r.), was 982·7 million roubles, *i.e.* scarcely 50 per cent of the pure product. (Therefore a worker before the revolution produced about twice as much as was paid in wages).

per month, whilst in 1922/23 a village teacher received not more than 15 roubles per month, *i.e.* scarcely 50 per cent of the intended norm.

However, it is necessary to take into account the extreme inequality between the structure of different classes, and for this reason, as well as the above information, we shall introduce a more detailed account based on data from statistical accounts.

In fact in our primary school, according to the facts in Census for 1920,[1] on average there are only 35 children to every teacher. But the teacher's work is spread quite differently in different groups according to the numbers of younger and older children in the groups.

Firstly, the percentage of those who are not successful is greater in the younger groups than in the older groups; and, for this reason in the first school year about 1,190 years of education are needed per thousand children, *i.e.* 19 per cent above the norm whilst, for the whole course of the first school stage, 5,320 years of education are required instead of 5,000, *i.e.* only 6·4 per cent above the norm. We consider that the time spent by the teacher is not decreased by a decrease in the number of older children — taking all the classes as a whole. But at the same time, calculating separately for each child, the time spent increases inversely proportional to the number of children in a class. Whilst 16 years of the teachers' time is necessary for every thousand pupils in the youngest group 44·5 years is needed for every thousand in the fifth group, *i.e.* 2·8 times more. We were very far from having four- or five-year courses in all our primary schools in 1924, and for this reason the number of pupils on average in one class in a school does not bear comparison for the older groups. But the figures do show that on average the number of children in the fifth class is 2·8 times less than the number in the first class.

From the given census, the average number of hours spent in education in a primary school is 142 days per annum, the average number of lessons given by a primary school teacher is 27 per week or 4·5 per day. Hence it is not difficult to determine the total expenditure of time both from the point of view of the pupils and from the point of view of the teachers. In general, an average pupil must spend 5·32 years or 755 days in order to complete the five-year course of the first stage of education and in order to teach him, the teacher must spend 0·18 years, 26 school days or 116 hours.

[1] See *Works of the Central Statistical Department* for 1924. At that time, the first five years of education belonged to the first stage, but today, as is known, the fifth year has been taken over to the programme for the second stage.

The qualifications of the teachers is given from the same census by the following data :

	Male	Female	Both Sexes
1. Average age (in years)	31·5	27·3	28·3
2. Average length of teacher's service (in years)	8·0	6·7	7·0
3. Average length of education (in years)	6·9	8·0	7·8

On the basis of the normal evaluation of the office work of corresponding quantities according to our coefficients (see Tables 9, 11, 12 below), the mean wage coefficient for a teacher of the first stage is about 3·3 times higher than for elementary workers of the first wage class. Thus translating to elementary work, about $0{\cdot}18 \times 3{\cdot}3$ annual units of the teacher's work must be spent for the five-year course of school of the first stage. If this unit is calculated in terms of the real wage norm for manual labour of 141 roubles, and we consider that the teacher's work cost only 50 per cent of the total expenditure on education in a primary school, then we find that 5·32 years spent in the first stage of education would cost us $0{\cdot}59 \times 141 \times 2 = 166$ roubles, which is about 31 roubles per annum.

This figure is no doubt a lot higher because of the increase in teachers' wages, since it is proposed to increase the average monthly wage not to 30 but to 38·8 roubles. But even with this increased norm, we find the following comparison between the profit and expenditure connected with each year of primary education (in old roubles) :

Year of Education	Expenditure	Profit	Balance
1st	18	1,565	1,547
2nd	28	1,200	1,172
3rd	39	782	743
4th	41	574	533
5th	44	470	426
1-5th	170	4,591	4,421
within this 1-4th	126	4,121	3,995

TABLE 7

AN EXAMPLE OF THE COST OF EDUCATION IN 1924 *

Type of School and Year of Education	Number of Pupils			Per 1,000 taking part						
		In one		Pupil's Work			Teacher's Work			
	With 1000 Pupils in 1st Group	School	Class (Course)	In Years	In Thousand Days	Number of Teachers	In Years	In Thousands of Days	In Thousands of Hours	In Thousands of Roubles
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1st stage (1920)										
1st year	1,000	36	36	1,190	169	16·0	19·1	2·71	12·2	8·9
2nd year	611	22	22	1,143	162	26·3	30·1	4·27	19·2	14·0
3rd year	412	15	15	1,083	154	38·6	41·8	5·95	26·8	19·5
4th year	225	8	14	1,070	152	41·3	44·2	6·27	28·2	20·6
1-4 years	2,248	81	—	4,280	608	—	135·2	19·20	86·4	63·0
5th year	101	4	13	1,064	151	44·5	47·3	6·72	30·3	22·0
Total 1-5 years	2,349	85	—	5,320	755	28·9	182·5	25·92	116·7	85·0
2nd stage (1920)										
6th year	58·2	45	45	1,050	160	38·5	40·4	6·14	23·5	21·1
7th year	41·4	32	32	1,050	160	55·0	57·7	8·77	33·5	30·1
8th year	28·4	22	22	1,050	160	81·0	85·1	12·90	49·5	44·4
9th year	20·6	16	(14)	1,050	160	118·3	124·2	18·90	72·5	64·8

Total for 6-9th year	148·6	115	—	4,200	640	61·6	307·4	46·71	179·0	160·4
5-9th year	249·6	—	—	5,264	791	—	354·7	53·43	209·3	182·4
1-9th year	2497·6	—	—	9,520	1,395	—	489·9	72·63	295·7	245·4
Higher Education (1923/1924)										
I (10th) yr.	10·6	277	277	1,050	170	56·5	59·4	9·63	14·9	62·0
II (11th) yr.	9·0	235	235	1,050	170	66·6	70·0	11·33	17·6	73·0
III (12th) yr.	5·9	154	154	1,050	170	101·6	106·7	17·3	26·8	111·2
IV (13th) yr.	2·5	65	(100)	1,050	170	156·3	164·0	26·6	41·2	171·0
V-VI (14th) yr.	1·0	26	(65)	1,050	170	241·0	253·0	41·0	63·5	264·0
I-V years	29·0	757	—	5,250	850	93·0	653·1	105·9	164·0	681·2
1-14 years	2,526·6	—	—	14,770	2,245	—	1143·0	178·5	459·7	926·6

* Calculated from the data of the Central Statistical Department and National Commissariat for Education. The school year at the first stage is 142 days, at the second — 152 days, for an institution for higher education — 162 days; the number of teaching hours per week for the teacher is, for the 1st stage — 27, for the 2nd — 23, for higher education — 9·3 hours. The wage coefficient for teachers of the first stage is calculated as 3·3, for the second — 3·7, for higher education — 7·4. With a rate of 11·75 roubles for a worker of the first grade, the corresponding rate for teachers is: 1st stage — 38·8 roubles, 2nd stage — 43·5 roubles, professors — 87 roubles per month. The coefficient for those remaining two years in the same class in the first stage is calculated from the mass of data for the census (for 8 provinces); amongst those who finished, there are fewer who remained two years in the same class than there are amongst those who left, and for this reason the totals of Columns (5) and (6) for the 1st stage are less the sum of this item; for secondary school and higher education, in the absence of statistical data, the percentage of failures is taken as the same for every year (5 per cent). It was not possible to calculate the number of teachers holding two posts at once, so the number in Column (7) is somewhat too large.

As can be seen from this, the profits due to the increase in productivity of the labour force are 27·6 times greater than the state expenditure on education in schools. Therefore the capital expenditure from the exchequer is paid with interest within the first 1·5 years and the next 35·5 years are pure profit from this capital without any further expenditure.

It would be difficult to imagine a more profitable investment for 'capital' even in a country of such great possibilities as our Soviet Russia. Also we have not yet taken into account the profit to the worker himself in the form of a higher wage.

In 1924 the State Plan included the final draft of the plan for the development of the school system in order to provide universal, compulsory education. According to this relatively meagre plan, only after ten years would we be able to guarantee primary schooling available for every child of school age from 8-12 years, and only that because no great increase in the number of children was expected because of the lowering of the birth rate during the war. Even to guarantee education for four years is something of an achievement. Even the sum required to carry out this extremely necessary reform was so enormous that it was very difficult to make up our minds really to go ahead with finding it.

On the other hand, it was sufficient to compare the size of this expenditure with the positive economic effects it would have in raising the productivity of the country, in order to understand what a loss every year of procrastination would cost.

Below we give a table showing this comparison. The calculation is carried out only for the territory of the R.F.S.S.R. without Central Asia, the Far East and the autonomous Republics, which in fact accounts for 73 per cent of all the children of school age in the U.S.S.R. The expenditure on upkeep and equipment for the schools is included in the sum for the expenditure as well as that on expanding the necessary complement of teachers and the building of new schools — only about 257 million roubles out of the total of 1,037 million for the majority of the building had been postponed until the second ten-year plan. The following circumstances were taken into account when calculating the effect of this expenditure. The average age at which a child starts to attend primary school in the first stage is, according to our data, not less than 9 years and about 4·3 years are spent on the four-year course, so that the age at which this child finishes school is 13·3 years so he has to wait about three years before he can start work. For this reason the positive effect of their education begins to be apparent only four years after the beginning of the reforms. Those finishing only 3-year school begin

TABLE 8

THE EFFECTIVENESS OF GENERAL EDUCATION*

Year of Reform	No. of Children 8-11 Years (in Millions)	No. in School			Expenditure in connection with the reforms				Economic Effect of this expenditure	
			Children	Teachers	Upkeep of Schools	Building	Preparing Teachers	Total	Total for 37 years (in Millions of Roubles)	For given Year (in Millions of Roubles)
		Thousands			Millions of Roubles					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1st	8·24	101·2	4,048	108·3	81·7	9·1	14·0	104·8	4,940	—
2nd	7·33	105·9	4,236	113·1	86·2	20·2	15·1	121·5	5,165	—
3rd	6·64	113·1	4,542	120·2	92·0	21·0	16·3	129·3	5,540	—
4th	6·14	122·6	4,904	129·8	102·4	20·0	18·0	140·4	5,980	—
5th	5·75	133·5	5,340	141·7	112·7	20·0	19·1	151·8	6,520	45·6
6th	5·75	138·5	5,540	146·7	114·6	22·0	18·9	155·5	6,760	125·4
7th	6·13	148·5	5,940	156·7	124·0	25·0	19·5	168·5	7,250	236·6
8th	6·63	163·5	6,540	171·7	136·6	30·0	20·0	186·6	7,980	385·2
9th	7·33	183·6	7,344	191·7	155·1	40·0	20·6	215·7	8,960	544·8
10th	8·23	208·7	8,348	216·2	176·8	50·0	21·3	248·1	10,170	714·4
1st-10th	—	—	—	—	1,182·1	257·3	182·8	1,622·2	69,265	2052·0

* In accordance with the 10-year plan of reforms for the R.F.S.S.R. excluding Central Asia, the Far Eastern sections and the autonomous republics.

work a year later, and those with 2-year school two years later and so on.

Calculating this order of beginning work and also the actual relation between the numbers of those leaving various classes of primary schools and their relative qualifications, we found that, on average, for each of those receiving education the sum increase in the wage evaluation of his degree of skill during the whole 37 years that he worked came to 1,220 roubles. That is about 33 roubles per annum, but according to the order for starting work, the first three years after finishing school do not give anything at all. For the fourth only 34 per cent, for the fifth 58 per cent, for the sixth 78 per cent and only for the seventh is the whole 100 per cent of the anticipated effect realized. With the introduction of compulsory primary education the percentage of people leaving the lowest classes will decrease, but the over-all effect of primary schooling will increase, but we are disregarding this particular effect for the moment. As a result we find the following (see Table 8 on page 299).

The expenditure for the whole 10 years exceeds 1,600 million roubles. Of course this is an enormous figure. But the effect of this expenditure, increasing the capital value of the working labour force for the country, at the same time should be evaluated at 69 billion roubles, *i.e.* 43 times greater. In this case, the capital expenditure will be recouped by the end of the first 10 years with a surplus corresponding to the improvement in national education. The profitability of the expenditure will exceed 125 per cent in the following three decades. The financial burden of these reforms is only felt by the country for the first 5-6 years of their introduction.

In this approximate calculation, we assumed that the norm for the increase in the degree of skill due to primary education which we calculated for the workers in factories and works — for machine-tool operators — would apply to all branches of manual labour. There is nothing unlikely in this assumption. But, bearing in mind that the great majority of our population are farm workers using the most primitive methods and machinery, it seems possible that the improvement in their education would produce an even greater effect than in the machine industry, since it would serve not only as the incentive to increase the yearly wages of the workers themselves, but also to bring radical rationalization of the primitive conditions of their farming.

Obviously, schooling of the second stage costs a great deal more. Twice as much of the teacher's time is required at this stage, and at the same time the teachers must be better qualified.

With the lowering of the number of children not succeeding in

schools of the second stage to 5 per cent,[1] we see from Table 7 that to complete such schooling of 4·2 years requires 0·307 years, 46·7 days or 179 school hours of the teacher's time. The qualifications of these teachers are given by the following table :

	Male	Female	Both Sexes
1. Average age (in years)	31·6	32·1	31·8
2. Average length of service (in years)	8·6	6·8	7·7
3. Average education (in years)	10·6	10·4	10·5

According to the normal evaluation for workers, the mean wage coefficient for such teachers would have to be put at 3·7 times higher than for unskilled work (first wage class). With the scale for workers of the first wage class at 11 r. 75 k. (141 r. per annum) this is about 44 r. 50 k. per month, or 520 roubles per annum. This means that, in the course of 4·2 years spent at 4-year school of the second stage, the amount of time spent on each child is $0{\cdot}307 \times 3{\cdot}7 = 1{\cdot}41$ units of the teacher's work at a cost of $141 \times 1{\cdot}14 = 160$ roubles. Adding such a sum to the other expenses, gives 320 roubles or 76 roubles per year of education.

This is a fairly small sum in comparison with the pre-war norms. In 1913, according to the figures of the People's Commissariat for Education, the total expenditure on one school child in the Boys' Gymnasium or practical schools was about 172 r. 50 k. per annum and only in girls' schools was this sum 75 r. 50 k. due to the exploitation of young girls and women as teachers. But even this meagre norm is still too high in comparison with the actual expenditure on secondary schools by the People's Commissariat for Education in the last few years. Thus, for example, according to a tentative budget for 1923/24, the mean credit for a school of the second stage came to 3,116 gold roubles per annum. For an average complement of 115 school children this does not come to more than 27 roubles per head. And even if we assume that the parents paid twice this, it does not nearly come to 76 roubles per head. Nevertheless, taking this value for the cost of education in schools of the second stage, we find the following balance between the expenditure and profits for further improvements in the education for manual labourers :

[1] For first stage schools, those who were unsuccessful made up 16 per cent of those in the first year in the country schools of 8 districts.

Year of Education	Expenditure	Income	Balance
School of 1st stage			
1-4 years	126	4,121	3,995
5th year	44	470	426
School of 2nd stage			
6th year	42	365	323
7th year	60	208	148
8th year	89	208	119
6th-8th years	191	781	590
5th-8th years	235	1,251	1,016
9th year	129	—	—
6th-9th years	320	—	—

From the comparison introduced it is not difficult to see that the significance of schooling of the second stage is not nearly as great as that of primary school. But here too, for an expenditure for the 5th to 8th years of education of 235 r. we have an addition to the productivity of a worker of about 1,251 roubles over his working life of 37 years, *i.e.* we recover the expenditure by 430 per cent and more. The capital expenditure is repaid during the first seven years, and after that the annual pure profit for the country over the remaining 30 years, is greater than 14 per cent.

II. WHITE-COLLAR WORKERS AND EDUCATION

The influence of education on the degree of skill of the labour in factories and works is a lot greater than would have been supposed. For this reason it is all the more to be expected that the influence of this education on the so-called white-collar workers should be even more significant.

For the statistical evaluation of the relative rôles of the various factors of the qualifications of office workers, we made use of the data provided by the 'service lists' for two of the main departments in Moscow — The People's Commissariat for Food and the Moscow Main Post Office — where the service lists were more carefully filled in than in other places. The choice of these departments was also dictated by the consideration that here we were dealing with office work — in the field of communications and distribution —

the necessity for which cannot be disputed. The increase in productivity in this field can be shown in a way that is particularly easy for us to grasp. The rôle of education in raising the quantitative and qualitative standard of this type of work is to be seen in a more obvious and significant manner.

Using exactly the same methods as we used with respect to the Leningrad metal workers, we made use of about 2,800 cards (1,059 working in the People's Commissariat for Food and 1,762 in the post office, these being the figures for 1923). But the column relating to the length of service was often not filled in on these cards. So in the end we were forced to confine ourselves to only 2,307 samples.

Another difficulty was that the degree of skill was evaluated on these cards in terms of the 17-step wage scale. In order to translate these values — for comparison with the data for the machine-tool operators — into lus, we proceeded as follows: The concept of a lu, *i.e.* the unit of the simplest work from the point of view of wages for it, corresponds to the current concept of a wage coefficient. If the rate for the 17th class is equal to 8 rates of the 1st class, then this wage coefficient means that for one day or one hour of work by a worker of the highest class we equate 8 such units of simplest work, *i.e.* 8 lu. Unfortunately the wage for work of different wage classes has changed a great deal of late in various departments. Of course, the ratios for wages in these classes or the wage coefficients have changed less. But even with these, we were forced to stop at that scale which, according to our information, was the most widespread for the wages of the corresponding categories of the mass of office workers. The rates beyond these scales were not included in the calculations as being outside the limits of the general norm.

We have given the degree of qualification everywhere both in classes and in lus in the following tables — with the following scale of translation from one to the other:

1st class	= 1·0 lu	10th class	= 3·4 lu
2nd ,,	1·2 ,,	11th ,,	3·8 ,,
3rd ,,	1·4 ,,	12th ,,	4·2 ,,
4th ,,	1·6 ,,	13th ,,	4·8 ,,
5th ,,	1·8 ,,	14th ,,	5·4 ,,
6th ,,	2·1 ,,	15th ,,	6·0 ,,
7th ,,	2·4 ,,	16th ,,	7·0 ,,
8th ,,	2·7 ,,	17th ,,	8·0 ,,
9th ,,	3·0 ,,		

For complete accuracy in such transformation it would have been necessary to carry it out in the order of marking out the material

on each card, as it was in the case of the machine-tool operators. But in the case in question we were not able to do this, and for this reason, the calculation is carried out with respect to group coefficients of the degree of skill, which results in a certain amount of inaccuracy in the figures arrived at in this way. As a result of the unequal growth of the degree of skill for the higher classes, the method of transformation we have applied gives slightly diminished results as can easily be confirmed by experiment. But, according to our estimates, at the very worst this under-estimation is not more than 8 per cent of the value calculated; also, since the error is always in the same direction, it cannot have any influence on the ratio of compared values.

Having made the above reservations, let us proceed directly to Tables 9 and 10.

As can be seen from Table 9, age has the same effect on the degree of skill in this case as it did for the case of manual labour, *i.e.* up to the age of 30, the degree of skill increases steadily, and thereafter, it decreases again. It is all the more interesting because the decrease in physical force towards old age cannot explain it since physical powers, generally speaking, play very little part in office work. It can only be assumed that mental powers decline towards old age in exactly the same way as physical powers do.

But at first glance, it is quite unexpected that these mental powers begin to decline so early on as only 30 years. In order to verify that this is in fact so, we decided to apply the following technique. Turning to the results for chess contests for the first-class masters of the game, we decided to subject them to a systematic examination as to the age of the winner and the loser. E. M. Trasov, who undertook this work, divided it into two groups; one with and one without draws. The group without draws consisted of 1,455 games — the results of 43 matches (1863–1911) and 34 international tournaments (1890–1914). In the other group a draw was counted as $\frac{1}{2}$ a point, and in this case it was necessary to make use of the results of 7,000 games won in these tournaments.

The theoretical training of all the contestants can be taken as equal in this case, as otherwise they would not have become masters. The length of time a contestant has been playing the game is also of little significance since, after the first few conventional moves, every game is a new one with an unrepeatable combination of positions. Long experience of conventional methods of playing is not likely to be of any help in such a situation. As to the influence of the individual talents of a particular master, this is excluded because games played by one and the same master at different ages are included in

TABLE 9

AGE AND DEGREE OF SKILL FOR OFFICE WORKERS

Groups according to Age (in Years)	No. of Samples	Original Data				Normalized Degree of Skill for			Smoothed Degree of Skill		
		Age	Service	Education	Degree of Skill (in Classes)	Service 9·33 Years	Education 4·2 Years	Service 9·33 and Education 4·2 Years	In Classes	In lu	
		In Years								Absolute	Per Cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
15-24	206	20·6	3·68	4·61	7·45	8·55	7·29	8·39	8·39	2·82	88
25-34	647	29·6	7·90	5·27	9·40	10·11	8·81	9·52	9·52	3·21	100
35-44	806	39·2	13·16	3·91	9·49	8·72	9·66	8·89	9·35	3·14	98
45-54	507	48·9	19·09	3·32	9·09	7·88	9·63	8·42	8·42	2·83	88
55-71	141	59·6	29·29	3·86	9·08	7·58	9·19	7·69	7·10	2·43	76
15-71	2,307	38·2	13·13	4·22	9·34	—	—	—	—	—	—

the calculations. Their talents, however, did not prevent them from having a greater energy and success at one age than at others. Let us examine then what is the age of maximum success in this intellectual sphere, 'all other conditions being more or less equal' (see Table 10).

As can be seen from Table 10, for chess this age must be taken as 32–33 years. The empirical figures for these ages almost entirely coincide with the line of the curve which is drawn. The mean

TABLE 10
AGE AND SUCCESS AT CHESS
(INCLUDING DRAWS)

Age (in years)	Mean	Number of games		Percentage of wins		Success (in % Maximum)
		Played	Won	Actual	Smoothed	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
up to 20	19·5	60	31·5	52·5	52·5	85·8
20-22	21·0	225	122·5	54·5	54·4	89·0
22-26	24·4	1,176	697·5	59·3	58·1	95·0
26-30	28·1	1,777	1,055	59·4	59·9	98·0
30-36	32·6	2,501	1,532	61·2	61·2	100·0
36-42	39·2	2,469	1,455	59·0	59·7	97·7
42-48	45·0	1,546	866	57·2	56·7	92·8
48-55	51·1	1,311	685	52·2	52·2	85·4
55 and over	59·5	1,006	456	45·4	45·4	74·3
Total	38·0	12,071	6,920·5	57·3	—	—

percentage of wins in this table is higher than 50. This is because for some of the players, obviously the weaker ones, the age was not known and their games had to be omitted from the calculations. Of course, in column 3 we have a double number of games corresponding to the age of each of the two contestants. Unfortunately, it was impossible to include in these groupings the age group for the defeated players corresponding to that of the winners. However, on the basis of the normal tournament procedure, of every contestant playing every other contestant irrespective of their age, it seems likely that this unknown age is near to 38 years, *i.e.* to the average age of all the contestants in tournaments.

In the following table, only those games have been used for which the age of both contestants at the time it took place is known. And in this case the assumption just made is entirely supported by the figures (see Table 11).

TABLE 11

AGE AND SUCCESS AT CHESS
(EXCLUDING DRAWS)

Age (in Years)	Mean Age	Games Played	Of these: Won — Games	Won — from Player Aged	Lost — Games	Lost — to Player Aged	% wins — Actual	% wins — Normalized	% wins — Smoothed	Success (in % Maximum
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
up to 25	21·5	223	120	39·6	103	36·4	53·8	50·4	50·4	88·4
25-29	27	606	340	38·4	266	35·4	56·1	56·0	56·0	98·0
30-34	32	463	263	39·4	200	35·7	56·7	57·1	57·0	100·0
35-39	37	455	229	40·0	226	37·8	50·0	51·1	55·6	97·5
40-49	43·8	593	283	40·4	310	38·0	48·5	47·5	51·3	90·0
50-59	54·5	463	198	38·8	265	35·8	42·8	40·7	40·7	71·4
60-70	63·4	107	22	32·6	85	35·7	20·6	20·9	20·9	36·7
Total	38	2,910	1,455	39·8	1455	36·6	50·0	—	—	—

It is true, the average age of those losing games is, as was expected, somewhat higher than that of those winning, but the difference in age for any particular group is not greater than 2-3 years (Columns (5) and (7)). Therefore the correction of the introduction of the same age (38 years) for all the contestants by the normalization methods given already above, did not produce any significant results. The empirical values of the percentage of wins and the normalized values both follow the same pattern, reaching a maximum at about 32 years. However, the smaller number of samples used in this case than in Table 10, gives a noticeable deviation from the smooth curve (Column (10)) at the ages of 37 and 44, which was not found with Table 10.

It is very characteristic that the smooth curves for the dependence of the degree of skill on age in all cases — both for the physical work and for the mental work and also for chess — Tables 3, 9, 10, 11 — are exactly identical not only in form and in the moment at which the maximum appears, but also are very similar in the numerical values for the shape of the graph at corresponding ages. Thus, if we take the maximum as 100, then the degree of skill at younger and older ages is expressed by the following figures :

DEGREE OF SKILL SHOWN IN VARIOUS TABLES

Age	No. 3	No. 9	No. 10	No. 11
22	94·5	92	91·5	91
32	100	100	100	100
42	98·5	95	94	92·5
52	90·5	86	84	76

As can be seen from these figures, the influence of age is felt least on the physical work of the machine-tool operators, it is a little stronger in the case of the mental work of the office workers, and is the greatest in the most demanding game of chess. The difference between the data for Tables 10 and 11 is very interesting. In the latter the success of any game is measured only in terms of the games won, *i.e.* draws are omitted. But it is much easier to draw than to win. We see that, in this case also, the success declines with age, and declines even faster since greater energy is required to sustain such a success. Some of the much older players could still manage to draw whilst a win is beyond them.

Mental energy declines particularly rapidly after the age of 60. Chess players over 65, of whom, it is true, there are very few included in our data, account for only 7 per cent of the victories. This fact

TABLE 12

EXPERIENCE AND DEGREE OF SKILL FOR OFFICE WORKERS

Age Groups According to Length of Service	Number of Samples	Original Data				Normalized Degree of Skill for			Smoothed Degree of Skill		
		Service	Age	Education	Degree of Skill (in classes)	Age 35·1 Years	Education 4·2 Years	Age 35·1 and Education 4·2 Years	In Classes	In lu	
		In Years								Absolute	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0-2	270	1·39	28·8	3·86	6·87	7·03	7·27	7·43	7·0	2·40	100
3-4	131	3·59	28·4	5·95	9·36	8·99	8·02	7·65	7·8	2·64	110
5-9	590	7·04	34·5	4·31	8·76	8·65	9·07	8·96	8·96	2·99	125
10-14	419	11·97	36·2	4·27	9·71	9·59	9·90	9·78	10·1	3·44	143
15-19	415	16·89	41·1	3·65	10·04	10·46	10·75	11·17	11·0	3·80	158
20-24	190	21·72	45·6	3·89	10·17	(10·97)	10·64	11·44	11·6	4·04	168
25-29	144	26·90	49·2	4·33	10·92	(12·07)	(10·77)	11·92	11·92	4·16	173
30-50	148	35·59	56·3	4·82	10·53	(12·53)	(9·93)	11·93	11·93	4·17	174
0-50	2,307	13·13	38·2	4·22	9·34	—	—	—	—	—	—

is extremely important from the point of view of scientific organization of the labour force. It is not without cause that all victorious revolutions produce leaders in the prime of life and, as experience shows us, that these leaders invariably defeat the aged ministers and generals of the obsolescent system in all fields of life.

Continuing our study of the part played by time spent in a profession in office work, we come to Table 12.

The increase in the degree of skill in this case, as in the case of physical labour, is particularly evident in the first years of service although it does not cease throughout the course of the whole working life of a worker. However, in this case, it is necessary to make one very important reservation. It must not be forgotten that this result is the average for very varied groups of office workers from messenger boys and watchmen to the most responsible organizers of collective labour in research departments. If we were to study the influence of the length of service for each profession separately, we should have no difficulty in showing that the increase in the degree of skill with length of service ceases quite early for many of them, whilst for others, the more skilled, it is later. So that only in the most complex branches of the professions, where the experience of a man's whole lifetime is perhaps needed, is this increase seen up till the very end.

The influence of the length of service for the office workers in comparison with the machine-tool operators can be seen from the following :

Service (in Years)	Degree of Skill			
	Labourers		Office Workers	
	In lu	In %	In %	In lu
0	1·28	100	100	(2·21)
2	1·61	126	111	2·45
5	2·00	156	126	2·78
10	2·42	189	147	3·26
20	2·85	223	179	3·95
30	3·03	237	188	4·16

As can be seen from these figures, the length of service is of greater significance to the labourers than to the office workers. But, after the first 5 years of service, this increase wanes so that the last 25 years of service only increase the degree of skill for the labourers by 1·03 lu in all, *i.e.* even slightly less than for the office workers (1·38).

The quite steep rise in the degree of skill for the labourers in comparison with that for the office workers for the first few years of

TABLE 13

EDUCATION AND DEGREE OF SKILL FOR OFFICE WORKERS

Age Groups According to Education (in Years)	Number of Samples	Empirical Data				Normalized Degree of Skill for				Smoothed Degree of Skill	
		Education	Age	Service	Degree of Skill (class)	Age 38·2 Years	Service 13·1 Years	Age 38·2 and Service 13·1 Years	In Classes	In lu	
		In Years								Absolute	Per cent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0-2	922	1·86	42·1	13·47	7·89	7·30	7·77	7·18	7·18	2·45	100
3-4	501	3·29	34·9	10·85	8·13	8·23	8·53	8·63	8·80	2·95	120
5-7	567	5·32	36·7	15·17	10·65	10·74	10·46	10·55	10·55	3·62	148
8-9	131	8·11	36·7	14·18	12·21	12·33	12·28	12·40	12·33	4·40	180
10-12	127	11·37	36·9	11·22	13·48	13·49	13·49	13·50	13·50	5·10	208
13-18	59	13·75	37·1	10·25	14·47	14·44	14·02	13·99	13·99	5·40	220
0-18	2,307	4·22	38·2	13·13	9·34	—	—	—	—	—	—

TABLE 14

DEGREE OF SKILL FOR WORKERS IN THE PEOPLE'S COMMISSARIAT FOR FOOD IN 1921

Wage Class	Number of Samples	Empirical Data				Normalized Degree of Skill in Classes for			
		Age	Service	Education	Wage Classes	Age 36·5 Years	Service 18·9 Years	Age 36·5 and Service 18·9 Years	In lu
		In Years							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1st-5th	233	35·5	19·82	2.26	4·83	4·80	4·71	4·68	1·74
6th-8th	151	35·6	18·83	3·66	7·62	7·60	7·63	7·61	2·64
9th-11th	123	35·8	19·41	4·89	9·84	9·82	9·77	9·75	3·30
12th-14th	174	37·4	18·30	8·95	13·22	13·24	13·30	13·32	4·99
15th-17th	114	37·8	17·42	10·02	15·73	15·76	15·92	15·95	6·95
1st-17th	795	36·5	18·89	5·51	9·54	—	—	—	—

service is obviously explained by the fact that the necessary skill is mastered quite quickly during the first few years, whilst thereafter for many of these labourers the further years of service add little or nothing in this respect. The mental skills which play a more significant part in office work are for the most part acquired at school so that professional service increases them further in a more steady fashion.

The significance of education for office workers can be seen from Table 13.

Education is obviously of great significance in the increase of the degree of skill for office work. Whilst the increase in mental and physical maturity with age from 16 to 30 increases the degree of skill of an office worker by 0·85 lu 'all other circumstances being equal', and whilst the 14 years of service increase it by 1·34 lu, higher education corresponding to 14 years at school gives an increase in the degree of skill of 3·81 lu, *i.e.* at least 2·8 times more than for the same length of service. We say 'at least' for Table 13 deals with mean coefficients found for very diverse categories of office work. No doubt high educational qualifications are only entirely utilized in very highly skilled work. Education is probably much more significant in such cases than it is shown to be by Table 13.

In order to verify this assumption we introduce another table referring to the office workers of the People's Commissariat for Food, in which the grouping has been arranged by us according to wage classes for these office workers (see Table 14).

In this case the method of grouping itself means that the groups of lowest skilled workers (classes 1-8) are sharply divided from the more skilled ones. The age and length of service for these groups turned out to be close to the average for all groups and the necessary corrections for the calculation of the normalized degree of skill — with this mean age and length of service — were entirely insignificant. What then differentiates these groups from one another ? As can be seen from the table, it is only the educational qualifications. But it is characteristic that, with these groups, the degree of skill of the office workers increases with each year of education significantly faster than it does in Table 13. At the same time, whilst according to Table 13 each successive year of education in school gives an ever-diminishing increase in the degree of skill, in this case conversely for the higher groups we find an acceleration in the increase in the degree of skill compared with the increase in educational qualifications.

This is best shown by the character of the corresponding curves, but the following comparative figures are sufficient indication. According to Table 13, in the groups with the highest educational

qualifications, 0·12-0·13 lu are added for every year of higher education whilst, according to Table 14, the corresponding addition for groups of workers of the highest wage classes reaches 1·8 lu, *i.e.* 15 times greater.

In order to clarify this difference we can introduce the following consideration. In Table 13, the group with higher educational qualifications consists entirely of people with higher education but some of them have already been working a long time and have managed to make use of their advantages so that they have reached the highest wage classes. On the other hand, others have only just started work and have not demonstrated their — as yet potential — advantages due to education, and are therefore still in the lower wage classes. As a result of this, the average degree of skill for such groups may appear much lower in comparison with the higher wage classes of Table 14 where those people who have already reached the 15-17th wage classes are concentrated, *i.e.* those who have already entirely developed their degrees of skill. And as they were indebted to high educational qualifications for this high degree of skill, the former is yielded here by the *total* wage evaluation.

However the potential advantages of education are only of theoretical interest to us before they are reflected in the wage evaluation of a worker. Therefore, when calculating the economic effect of education in schools, we make use of the coefficients in Table 13. What does this give us ?

Education plays a considerably larger part in the process of increasing the degree of skill for an office worker than for a manual labourer. Of course, only the first years of education can be used for the comparison. Here, for example, are some figures :

Year of Education	Increase in the Degree of Skill (in lu)		
	Labourers	Office Workers	Difference (in %)
1st	0·30	0·43	43
2nd	0·23	0·40	74
3rd	0·15	0·35	133
4th	0·11	0·33	200
5th	0·09	0·32	256
6th	0·06	0·31	417
7th	0·04	0·30	650
1st-7th	0·98	2·44	149
from these 1st-4th	0·79	1·51	91

As can be seen from these figures, a 7-year course gives office workers an additional degree of skill about 2·5 greater than for labourers. Even a 4-year primary school course gives the office worker an additional 90 per cent greater than for labourers. This is how the matter stands also with present low wage scales for office workers with a coefficient 1 : 8. Possibly the above calculation for the profitability of universal primary education calculated with the norms for the evaluation of physical labour, would increase even more if office work were taken into consideration.

But a completely different picture is found when we try to evaluate the profitability of *higher* education with the coefficients of Table 13. Starting from the scale for the 1st wage class of 11 r. 75 k. and supposing that a youth of 16 without any service or education is entitled to this wage as is being established by our country at present, we calculated the number of these elementary scales and the total for all wages earned during a working life in an office by means of additions for every year of service, age and education (from Tables 9, 12 and 13).

With an educational qualification up to 8 years, we took the start of the career conditionally to be 16 years and with each additional year of education we raised the age of starting work by a year and correspondingly decreased the total number of years worked. This calculation gave us an approximate figure for total of wages earned for a whole working life of an office worker with varying educational qualifications. We used the norms of Table 7 to calculate the cost of education, doubling them because of other expenditure besides that on teaching staff.[1] As a result we obtained the following comparative figures.

The profitability of primary and secondary education is quite clear from these figures. But on the other hand, by the third year of higher education, it is already a long way from recouping the expenditure on education and the loss in wages due to the delay in starting work. The deficit increases with each successive year of education and the total for five years of higher education is about 130 roubles for every student completing the course. The cost of university education is therefore taken as 1,362 roubles. However, since this education is entirely free, the profitability of higher education for those undergoing it is still quite high — more than 1,200

[1] As a measure of the degree of skill of scientific workers of the universities we took — at 45 years of age, service of 24 years and education of 13-14 years (see our work 'Degree of Skill and Natural Gifts') a tariff coefficient 7·4 which corresponds to 16-17th class. On the basis of a wage scale of the first class of 11 r. 75 k. this gives 87 r. a month, but according to the budget for 1923/24 their actual wages only reached 60 r., however in 1924/25 their needs were calculated as 1,000 roubles per annum or 83 roubles per month.

TABLE 15

THE ECONOMIC EFFECT OF EDUCATION FOR OFFICE WORKERS

(FOR SCALE 1 : 8)

Age of Starting Work (in Years)	Total Years spent in		Wage Class	Wage Coefficient		Life's Wages		Effect of Education (in Roubles)	Cost of Education (in Roubles)	Balance	
	Education	Work		Calculated	Smoothed	In Rates of 1st Class (Column 3 × 6)	In Roubles (Column 7 × 140 r)			Total (Column 9 – Column 10)	For Last Year of Education
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
16	0	37	6·91	2·37	2·37	87·7	12,278	—	—	—	—
16	1	37	8·56	2·87	2·87	106·2	14,868	2,590	18	2,572	2,572
16	2	37	9·89	3·36	3·36	124·3	17,402	5,124	46	5,078	2,506
16	3	37	11·06	3·82	3·85	142·5	19,950	7,672	85	7,587	2,509
16	4	37	12·01	4·20	4·31	159·5	22,330	10,052	126	9,926	2,339
16	5	37	12·81	4·69	4·76	176·1	24,654	12,376	170	12,206	2,280
16	6	37	13·59	5·15	5·18	191·7	26,838	14,560	212	14,348	2,142
16	7	37	14·34	5·60	5·57	206·1	28,854	16,576	272	16,304	1,956
16	8	37	14·89	5·93	5·94	219·8	30,772	18,494	361	18,133	1,829
17	9	36	15·30	6·30	6·30	226·8	31,752	19,474	491	18,983	850
18	10	35	15·63	6·63	6·63	232·0	32,480	20,202	615	19,587	604
19	11	34	15·90	6·90	6·90	234·6	32,844	20,566	761	19,805	218
20	12	33	16·15	7·15	7·15	236·0	33,040	20,762	983	19,779	– 26
21	13	32	16·38	7·38	7·38	236·2	33,068	20,790	1325	19,465	– 314
22	14	31	16·60	7·60	7·60	235·6	32,984	20,706	1853	18,853	– 612

roubles. The influx of students to places of higher education, which in the last few years have opened their doors to those who are working, is caused not only by ideological inducements but also by purely economic grounds. It was clear to everyone that very, very soon the country would be in dire need of many doctors and teachers, and, more especially, of even more engineers and technologists. However, at the given time, due to the war and the blockade, the restricted economy and low budgets gave rise to the famous 'over production' of the intellectual labour force.

This seems highly paradoxical at the first glance. However, it reflects a very real picture of the relation of supply and demand for workers in the intellectual labour force. True, this over-production was very relative. In the country districts millions of people who were ill were deprived of any medical aid but we had no means of paying doctors and thousands of doctors remained out of work in the main cities and main centres of population. About 70 per cent of our population was illiterate, but there was nothing with which to pay the teachers and tens of thousands of them swelled the ranks of the unemployed. But, if the demand for intellectual labour fell sharply on grounds of solvency during these years, the production of new intellectuals in the universities actually increased noticeably during the revolution. In 1913 we had only 90,000 students whilst in 1923 there were upwards of 200,000, *i.e.* 120 per cent more.

The effect of this, of course, was felt strongly in the wages for workers from the intellectual labour force. In 1913 the average wage for manual labourers, taken in that proportion of production which corresponds to the present-day ratio for them in industry, reached 300 roubles per annum. With the wage coefficient for 1913 for these workers of 2·15, this is 140 roubles per annum for the 1st wage class, *i.e.* 11 r. 60 k. per month or 50 k. per day. In 1913, the scale for an ordinary university teacher came to 3,000 roubles per annum and the head of a branch of a central office received the same.[1] This corresponds to the 17th class in the present-day scale, but the present scale for the 17th class on average is not more than 1,200 roubles per annum. In other words, in 1923 the work of someone in the 17th class was only eight times as costly as that of a simple labourer in the 1st class; in prewar days this ratio was not less than 20 : 1, *i.e.* at least 2·5 times higher.

The time has come to put the question: was there also a loss for higher education at the prewar evaluation for the intellectual

[1] We are no longer dealing with such posts as the director of a department, who received 8,000, the sub-director 5,000 and so on; even clerks of the Vth class received 3,750. As is known, the salaries of engineers and similar specialists with higher educational qualifications were even higher.

labour force ? In order to answer this question we shall carry out the necessary approximate calculation. Starting from the ratio of 20 : 1 and supposing that each successive wage class is paid more than the previous one always in the same percentage, we would find the following hypothetical wage scale for comparison of the prewar with the present-day 8-division scale :

	Wage Coefficient for Scale			Wage Coefficient for Scale	
Class	1 : 8	1 : 20	Class	1 : 8	1 : 20
1st	1·0	1·00	10th	3·4	5·38
2nd	1·2	1·21	11th	3·8	6·49
3rd	1·4	1·45	12th	4·2	7·83
4th	1·6	1·75	13th	4·8	9·44
5th	1·8	2·11	14th	5·4	11·39
6th	2·1	2·55	15th	6·0	13·74
7th	2·4	3·07	16th	7·0	16·58
8th	2·7	3·70	17th	8·0	20·00
9th	3·0	4·46			

Using these ratios to transform the coefficients of Column (4) in Table 15 to prewar values, and taking the annual scale for the 1st class for 1913 as 140 prewar roubles, we find another expression for the economic effect of education. Naturally, with a higher wage rate for the intellectual labour force, the cost of education per participant would also increase in the same proportion. In fact, according to prewar data, the cost for educating one student in any institute for higher education, including teachers' payments, came to something between 260 to 300 roubles, whilst in 1923/24, according to the budget figures, it only came to 77 roubles per annum.[1] The upkeep for a pupil in secondary school in 1913 including the teachers' fees was not less than 116 r. 50 k., whilst in the 1923/24 budget it was not more than 27 k.[2] However, taking into account both this difference, which is particularly important for higher classes of secondary schools and higher institutions that require

[1] According to the estimates for the Ministry for National Education for 1913, for 48,628 students the exchequer provided 7,652 roubles to maintain the students, 2,101 thousand for expenditure on building and 320 thousand on training university teachers. Besides this, the cost for teaching staff was 2,639 thousand not counting other special means and capital. The total comes to 12·7 million roubles or not less than 261 roubles per student. The figure 77 for the 1923/24 estimates does not include supplementary scholarships from local funds and economic organizations, but even with the addition of these, at the very best, the figure would only be 100-120 roubles per annum.

[2] In 1913 the budget for 1,598 establishments for secondary education for boys and girls with 540,000 children was 62·9 million roubles.

teachers with high qualifications, and all the necessary alterations to the data for Table 15, we obtain the figures — naturally very approximate figures for prewar years — given in Table 16.

As can be seen from these figures, with the prewar evaluation of labour, the expenditure on higher education was entirely recouped. True, the approximate calculation we have made is more by way of being an illustration. But it can be confirmed by theory.

The fluctuating laws for the market no doubt had to take into account in the evaluation of labour the expenses of the production of highly skilled labour. If a four-year course of higher education were not enough for doctors and engineers and a fifth were needed, then the market must entirely pay for this last, fifth year of education. Otherwise there would not be sufficient stimulus for the students to lose this last year at their books and for society to bear the expenses connected with it, and we would then not obtain the number of doctors and engineers which we need but perhaps a surplus of say teachers and lawyers. Our calculations entirely confirm this consideration. According to these calculations not only is expenditure on higher education on average for all years recouped, but it is even recouped for the last expensive fifth year with very few people.

This must be compared with another fact, to be seen from all our tables — the wage coefficient expressed in classes added by each additional year of education decreases steadily despite the increasing expensiveness of each year of this education for higher age-groups. This 'law' of the diminishing productivity of education, which is analogous to the exactly similar decrease in the productivity of each successive year of service with respect to increase in the degree of skill, merits our particular attention.

How can this fact be explained? This question has been extremely little investigated. It is possible that it is a matter simply of the greater plasticity and receptivity of a young brain, the untapped resources of which give a particularly rich harvest after the first sowing and, thereafter, by degrees, as the brain is confined by a variety of knowledge gained at school and thousands of acquired reflexes, this plasticity is lost, our brain power is mechanized, we become accustomed to act according to a stereotyped mould in all new undertakings, and all that we gain in speed and accuracy due to such habitual reactions we lose in disability to perceive new methods of thinking and techniques of working. It is possible, on the other hand, that to explain this law we must take into account a whole series of other considerations from various fields of the sciences of man and human society. However, the fact remains a fact.

The degree of skill of a worker, *i.e.* his ability to work, his

TABLE 16

BALANCE OF GAIN AND COST OF EDUCATION

Age at Starting Work (in years)	Number of Years spent		Wage Class	Wage Coefficient		Life's Wages		Effect of Education (in Roubles)	Cost of Education (in Roubles)	Balance	
	on Education	on Work		Calculated	Smoothed	In Scales of 1st Class	In Roubles (Column 7 × 140 r.)			Total (Column 9 – Column 10)	Per Year of Education
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
16	0	37	6·91	3·02	3·02	111·7	15,638	—	—	—	—
16	1	37	8·56	4·13	4·13	152·8	21,392	5,754	18	5,736	5,736
16	2	37	9·89	5·28	5·28	195·4	27,356	11,718	46	11,672	5,936
16	3	37	11·06	6·57	6·57	243·1	34,034	18,396	102	18,294	6,622
16	4	37	12·01	7·85	7·85	290·4	40,656	25,018	164	24,854	6,560
16	5	37	12·81	9·13	9·13	337·8	47,292	31,654	230	31,424	6,570
16	6	37	13·59	10·59	10·45	386·6	54,124	38,486	314	38,172	6,748
16	7	37	14·34	12·19	11·77	435·5	60,970	45,332	435	44,897	6,725
16	8	37	14·89	13·48	13·05	482·8	67,592	51,954	612	51,342	6,445
17	9	36	15·30	14·59	14·25	513·0	71,820	56,182	871	55,311	3,969
18	10	35	15·63	15·53	15·35	537·2	75,208	59,570	1,069	58,501	3,190
19	11	34	15·90	16·29	16·29	553·9	77,546	61,908	1,302	60,606	2,105
20	12	33	16·15	17·09	17·09	564·0	78,960	63,332	1,658	61,664	1,058
21	13	32	16·38	17·86	17·86	571·5	80,010	64,372	2,205	62,167	503
22	14	31	16·60	18·63	18·63	577·5	80,864	65,226	3,050	62,176	5

economic productivity, increases, judging by market values, more slowly than the number of years spent on his education. If this is true, then the high profitability of primary education and even secondary education in comparison with higher education is sufficiently clarified by this 'law' of diminishing productivity of education. If even the least productive last year according to the laws of the market should be entirely recouped by the workers' wages, then the more productive years of education in this respect, will be the more profitable the higher their productivity and the lower the expenses connected with them.

Here the question arises : is it possible with respect to intellectual work to identify the degree of skill with the conception of more productive work as it is for manual labour if in this case there is no visible end product ? However highly the work of a doctor or a teacher may be valued, it cannot be compared with the productive work of a blacksmith or a turner, for mental work does not produce market values. However, there are some errors in such remarks as well as some truth. Of course, the work of a doctor or a teacher cannot be called production, but nevertheless, even from the point of view of a capitalist, it can be more or less productive.

At one time the physiocrats only recognized agricultural labour as productive. But at the time of Adam Smith this conception had already broadened to include every form of labour which produced goods. In some formulations it has an even wider scope so that productive work covers all hired labour if it not only pays for itself but also has some 'surplus value' to the owner. Karl Marx also agreed with this last, very broad, conception of productive work, with the one reservation that 'productive and unproductive work are only different from the point of view of the owner of the money, the capitalist, never from the point of view of the worker'.[1]

From this point of view, both in the production of goods and in the production of the services from mental work, the manual labourer, the unskilled worker, the engineer, the writer, the clown, the concert singer and even the prostitute in a brothel are equally productive from a capitalistic point or view, since they are all hired and enrich

[1] K. Marx, *The Theory of Surplus Value*, Moscow, 1955, p. 127. In another place Marx calls such a capitalistic evaluation of productivity 'relative' as opposed to 'absolute' suitable to forms of society, alien to exploitation : 'The very existence of a capitalist class and capital itself is based on the productivity of labour but not its "absolute" but its "relative" productivity. If a worker's day was spent only on maintaining the worker himself, *i.e.* on reproducing his working force (301) then, on absolute considerations, his work would be productive since he would reproduce, *i.e.* he would constantly be compensating for the sums he needs (which are equal to the value of his own working force). But he would not be productive in the capitalist sense of the word since his work would produce no "surplus value"' (*ibid.* p. 122).

their employers.[1] The services of school teachers are no doubt equally productive since they are engaged in the production of goods of great importance to a capitalistic market — the labour force — and the services of a doctor are also equally productive since he is occupied, as Marx said, in the continuous 'repairing' of these goods — the labour force. Of course, this is always on condition that they are working for an employer, who extracts the surplus value of their unpaid labourers, as is the case, for example, in private schools, 'teaching factories' as Marx calls them, private hospitals and other similar capitalistic institutions.[2]

But if we turn from conditions of private economy which are only characteristic of capitalist society, and consider the matter from the point of view of the conditions prevailing in our Soviet society, where the forms of work which would be considered as most productive are those which most enrich not the individual but the society as a whole, then, of course, the classification of various forms of work according to their productivity is quite different. Thus, for example, the working force of the prostitute who rots in the brothel cannot be considered as productively employed, but the work of a doctor or teacher in our country where all factories are nationalized is considered sufficiently productive, not only in those 'teaching and repairing factories' which are organized in the capitalist way — to extract huge fees — but also in those which are organized by the state — to increase the productivity of the nation.

We have already seen above how the teachers increase the nation's productivity. It is enough to say that, even with the present far from perfect organization of education, not more than 13·2 years are spent in the process of producing any student finishing a higher course, and this raises the productivity of this worker — according to the calculation for his total working life — by 148 years of simple work of the first class, *i.e.* by 11 times more than the expenditure on his education.[3] It is more difficult to evaluate the work of doctors in lengthening the working lives of the many hundreds of workers treated by them. But, generally speaking, the economic effect of doctors' work is not impossible to calculate, and is no doubt quite sizeable.

The same is true of many other forms of intellectual workers — scientists, writers, painters — whose economic effect is not taken into account in capitalist economies. However, their contributions

[1] K. Marx, *The Theory of Surplus Value*, Moscow, 1955, pp. 127, 134, 136.
[2] See K. Marx, *The Theory of Surplus Value*, p. 136.
[3] See Tables 7 and 15. The number of years of teachers' work, shown in Table 7 is translated into simple work according to the wage coefficient given in the table and then doubled to take account of other expenses.

to our culture which help to raise the cultural level of the country are not without influence even on the material basis of every national economy — the productive resources and the living productive force.

With the planned methods of reconstructing the national economy on a new, socialist basis, it is essential to take account not only of powerful material factors in this revolution such as electrification, but also of less tangible effects such as national education, without which it would scarcely have been possible to carry out successfully the plan for electrification.