

## A PRELIMINARY TEST OF THE COAL MINE RATING SCHEDULE OF THE ASSOCIATED COMPANIES.

BY

E. H. DOWNEY.

The present paper is not designed as an original contribution to the theory of schedule rating, nor even as a critical discussion of the particular schedule rating plan here under review. It professes to do no more than present the salient results of that plan as revealed by the first inspection of coal mines in Pennsylvania. The interest of these results lies in the novelty of the plan itself, and in the fact that similar statistics relative thereto have not heretofore been published.

Compensation insurance of coal mines in Pennsylvania is confined to the Associated Companies, the State Workmen's Insurance Fund, and the Eureka Casualty Company (which insures only the properties of a particular mining corporation). Partly because of the limited number of competing carriers, and partly because the Associated Companies had already perfected machinery for the purpose, an arrangement was made whereby the inspection department of the Associated Companies acts, for the present, as a central bureau for the inspection and rating of coal mines. The agreement provides that the service rendered by the said inspection department to the State Fund shall be identical in every respect\* with that to the Associated Companies, and that its operations shall be subject to the direct supervision and visitation of the Insurance Department.

In pursuance of this arrangement, some fifteen hundred first inspections have been reported to the Insurance Department. Of this number, 1,135 are included in the present survey.† A further

\* That is, as respects schedule rating inspections and re-inspections.

† State Fund risks are omitted because written at a different base rate so that a re-computation would be required to make the results comparable. A number of inspection reports, moreover, were received too late to be included in the tables. In a later number of the *Proceedings*, I expect to publish a full summary of all coal-mine inspections and re-inspections.

deduction is to be made of 215 minimum risks,† leaving 920 mines on which the returns are given. Table I shows the payroll, premium, number of employees and average annual earnings, as indicated on the inspection reports and policy proposals for both anthracite and bituminous mines. These figures are of course to be read in the light of their source as advance estimates only. Still, they serve to indicate the extent of exposure involved.

TABLE I.  
EXPOSURE OF RATED MINES.

Classification.	Number of Risks.	Payroll.	Premiums at Base Rate.	Number of Employees.	Average Annual Earnings.
Both.....	920	\$52,552,100	\$2,105,033	92,400	\$569
Anthracite....	75	11,393,900	528,675	20,400	559
Bituminous...	845	41,158,200	1,576,358	72,000	573

To explain the rating returns upon these risks, it is necessary to recall the principal features of the Associated Companies' schedule. It will be remembered that the schedule consists of charges only‡ expressed in points which are convertible into premium rate by a simple algebraic formula.\* The charge values are derived from statistics of fatality rates by accident causes as compiled by the United States Bureau of Mines. There are some 148 specific items all told, arranged in twelve groups as shown by Tables IV and V. By no means the least interesting feature of the schedule is the device for securing a balance of premium income with basis rate. The base rates on coal mines, as on other classifications, are intended to cover the expected aggregate losses. Hence schedule

† Less than \$100 premium for bituminous, or \$200 for anthracite mines.

‡ See paper by H. M. Wilson, *Proceedings*, Vol. II, p. 39.

\*  $y = B(1.00 - U) + x(UB/L)$ , where  $B$  is base rate,  $U$  = maximum reduction (in per cent.) from base rate,  $L$  = normal charges,  $x$  = charges on specific risk,  $y$  = rate sought. For Pennsylvania  $B = \$4.64$  for anthracite and  $\$3.83$  for bituminous mines,  $L = 30$  for anthracite and 25 for bituminous mines,  $U = 40$  per cent. of base rate. Substituting the formulæ become respectively:

$$y = .60B + x \frac{.40B}{30} \quad \text{and} \quad y = .60B + x \frac{.40B}{25}$$

or

$$y = \$2.78 + x \frac{\$1.86}{30} \quad \text{and} \quad y = \$2.30 + x \frac{\$1.53}{25}$$

rating should affect a redistribution of premium income without altering its total amount. In a schedule of charges only this result was sought by determining the number of charge points which would apply upon a "normal" or "average" mine, and fixing the neutral point of the schedule at such number. For Pennsylvania these norms are 25 points for bituminous and 30 for anthracite mines. That is to say, if the total charges upon a bituminous mine are 25 points, the mine will pay the basis rate; if the charges are zero, the rate is 60 per cent. of manual; if the charges exceed 25, the rate is more than manual. A marked advantage of this plan is that the balance of premium increases and decreases can be readjusted at any time by changing the norms without affecting the charge items or their values. This feature should especially commend itself to those who have wrestled with the problem of correcting the effect upon premium income of the Universal Analytical Schedule.

Tables II and III show to what extent this device accomplished the desired results. It will be seen that the schedule produced an approximate balance upon the first inspections of bituminous mines, the aggregate departure from manual premium being barely 2 per cent. The net reduction was much greater upon anthracite mines, viz., 8.4 per cent. of base rate. Taking both classes together, the net reduction from manual premiums was 3.7 per cent.—a remarkably close balance. By reference to the charge groups it will appear that the normal of 25 charges is approximately correct for bituminous mines, whereas the anthracite norm of 30 charges seemingly is pitched too high. In point of fact the weighted average charges actually developed were nearly identical for anthracite and bituminous mines.\* A very commendable result is the small dispersion in both tables. A majority of the risks, and the bulk of the payrolls and premiums, fall within the groups just above and below the basis rate. The number of maximum reductions, as also the number of increases of more than 30 per cent., is extremely small. No single risk produced more than 58 charges, or

\* Since this paper was prepared Mr. H. M. Wilson has explained that the normal charge of 30 upon anthracite mines was purposely fixed too high with the intention of reducing aggregate premium income as compared with base rate. The base rate was computed from statistics of accidents compiled for a period when the mine law applicable to anthracite mines was less stringent, and the hazards (presumably) greater than at present. The schedule was used to correct a presumed excess of base rate.

an increase of 51 per cent. over manual. Be it remembered that there are no arbitrary stop limits to control charges and credits, so that this result is due purely to the shrewd selection of charge values.

TABLE II.\*  
RATE DISTRIBUTION OF ANTHRACITE MINES.

Rate Group.	Charge Group.	No. of Risks.	Payroll.	Premium at Base Rate.	Adjusted Amt.	Premium. % of B. R.
Total.....	23.7	75	\$11,393,900	\$528,675	\$484,340	91.6
60- 70%	0- 7	1	30,000	1,392	875	63
71- 80%	7-15	10	320,900	14,890	11,193	75.1
81- 90%	15-23	25	3,391,900	157,382	135,658	86.4
91-100%	23-30	30	6,585,600	305,571	284,486	93.1
101-110%	30-37	7	805,500	37,376	38,588	103
111-120%	37-45	2	260,000	12,064	13,540	112
121-130%	.....	.....	.....	.....	.....	.....
Over 130%	.....	.....	.....	.....	.....	.....

TABLE III.\*  
RATE DISTRIBUTION OF BITUMINOUS MINES.

Rate Group.	Charge Group.	No. of Risks.	Payroll.	Premium at Base Rate.	Adjusted Amt.	Premium. % of B. R.
Total.....	23.8	845	\$41,158,200	\$1,576,358	\$1,543,322	97.9
60- 70%	0- 6	7	39,300	1,505	1,007	67.1
71- 80%	6-13	59	1,447,400	55,437	42,607	76.9
81- 90%	13-18	202	9,339,200	357,693	304,073	85
91-100%	18-25	316	12,774,800	489,273	467,949	95.6
101-110%	25-31	201	12,738,400	487,881	505,269	103.6
111-120%	31-37	44	3,298,300	126,326	143,602	113.7
121-130%	37-44	9	662,300	25,364	31,551	124
Over 130%	Over	7	858,500	32,879	47,264	144

How far the balance of premium income will be affected by reinspection cannot, of course, be determined until the reinspections have been made. It should be stated, however, that the schedule was designed to produce a balance upon first inspections. That is to say, the normal charges were intended to reflect the conditions of unimproved mines and not of mines improved by the effects of

\* In the above tables Column 1 shows the rate groups in per cent. of base rate and Column 7 shows the adjusted premium in per cent. of manual premium. Column 2 shows the charge limits, in points, for each group, while the first line gives the weighted average charges upon all risks.

schedule rating. This procedure was logical, since the basis rates were calculated altogether from accident statistics which antedated the Compensation Act, and the introduction of schedule rating. It is to be expected, therefore, that the reinspections will show a considerable reduction from basis rates, consequent upon the removal of conditions for which charges were made in the first inspections. To offset such reductions the framers of the schedule hope that the correction of these conditions will produce a corresponding decrease in the number and severity of injuries. How far this hope will be realized time alone can tell.

Tables IV and V exhibit the charges developed upon first inspections in points and in per cent. of the total, by item groups. Safety measures (Item II), it should be explained, comprise warning signs, illumination, signal system, refuge chambers, escape ways, mine maps, rescue crews, first aid and hospital provisions and toilet facilities. The other titles are self-explanatory. It will be observed that there is a fairly close correspondence between the per cent. of total charges actually developed and the state weights. The closest correlation is found in the most important group of charges—those for conditions affecting falls of roof and coal. The widest discrepancy appears in the two "moral hazard" groups (I and II). It must be owned that many of the items in these groups are too vague to admit of uniform or accurate applications. The deficit of realized, as compared with expected, charges in Group I, is accounted for, in large part, by the waiving of charges in doubtful cases. There is a rather consistent deficit in the minor items, the exact meaning of which is not altogether clear. Taken as a whole, however, the correspondence is remarkably close, which goes to say that the schedule faithfully reflects actually existing conditions in Pennsylvania mines.

Unfortunately, considerations of time and space forbid the insertion of similar tables exhibiting the charge items in detail. Such detail would show that barely 10 per cent. of the total standard charges are for conditions not within the control of the operator.\* The schedule thus provides an important prerequisite to the use of schedule rating for accident prevention. Quantitatively, however, the charges are based purely upon the insurance value of the hazards involved, without reference to the cost of correcting defects.

\* These charges are on Items 26, 61, 63, 107, 111 and 112.

How far the charges will prove effective can only be determined from the results of inspections.

To conclude, this preliminary test indicates that the Associated

TABLE IV.\*  
CHARGES UPON ANTHRACITE MINES.

Items.	Reduced Charges.	% of Total Charges.	State Weights.
All items .....	169,728	100	100
I. Safety organization.....	23,480	14	20
II. Safety measures.....	55,760	33	20
III. Surface hazards.....	9,779	6	8
IV. Shaft hazards.....	2,379	1.4	3
V. Underground haulage.....	7,424	4	8
VI. Falls of roof or coal.....	42,575	25	25
VII. Explosives.....	19,934	12	6
VIII. Electricity.....	249	—	2.5
IX. Mine gas.....	4,627	3	4.5
X. Coal dust.....	0	—	—
XI. Mine fires.....	767	.5	.5
XII. Miscellaneous underground hazards...	2,754	1.6	2.5

TABLE V.\*  
CHARGES UPON BITUMINOUS MINES.

Items.	Reduced Charges.	% of Total Charges.	State Weights.
All items.....	1,845,859	100	100
I. Safety organization.....	205,950	11	20
II. Safety measures.....	674,880	37	20
III. Surface hazards.....	32,690	1.8	2.5
IV. Shaft hazards.....	4,971	—	1.5
V. Underground haulage.....	139,005	7.5	9
VI. Falls of coal or roof.....	649,068	35	34
VII. Explosives.....	37,193	2	1
VIII. Electricity.....	6,475	.3	1.5
IX. Mine gas.....	26,187	1.5	3.5
X. Coal dust.....	56,960	3	5
XI. Mine fires.....	4,378	—	.5
XII. Miscellaneous underground hazards....	8,102	.4	1.5

Companies accurately forecast the working of their schedule. It produces an approximate balance of premium increases and decreases upon first inspections and it distributes the total charges

\* Reduced charges are 100 times the final value of the charges in points. State weights are the standard relative values of the respective items for Pennsylvania.

among the several items in nearly the proportion intended. All this argues a careful statistical and engineering study of the coal mining industry upon the part of the schedule makers. It remains only to add a word of caution against basing any final conclusions upon the results of a preliminary test. The balance of premium increases and decreases does not prove that the charges accurately reflect the insurance value of the hazards charged for: that can be established only by accurate statistics of compensation cost by accident causes. Similarly, reinspections will not determine the effectiveness of the schedule for accident prevention. The reinspections will show whether and how far certain definite conditions have been remedied, but any resulting decrease in accident frequency and severity must be measured by accident statistics carefully kept and compared over a series of years.