The results of rock crushing by blasting are markedly influenced by the character of the original jointing of the rocks. It is found that when highly fissured rocks are blasted with a low specific explosives consumption, the empirical distribution is not unimodal [1]. It has also been observed [2] that 85-90% of the oversize from blasting crushing in jointed limestones comes from natural structural units. Guided by these experimental facts, I have suggested a theoretical scheme for crushing of block-structured rock by blasting [3].

I made the following assumptions.

1. When the medium is crushed by blasting, each natural structural unit is broken.

2. The law of fracture of a single structural unit coincides with the normalized Rozin--Rammel relation (a Weibull distribution truncated with respect to the dimensions of the structural units).

3. The shape parameter of the latter, $n$, is regarded as constant for all the fractions; the scale parameter $x_0$ depends on the dimensions of the blocks.

The reduced resultant distribution density is

$$f(x) = \int_{x}^{\infty} f_1(t) r(t, x) \, dt,$$

where

$$r(t, x) = \frac{1}{1 - \exp\left[\frac{-1}{\frac{x}{x_0}} x_0^n\right]} \exp\left[\frac{-1}{\left(\frac{x}{x_0}\right)^n}\right];$$

$f_1(x)$ is the initial distribution density (expressed in fractions of the volume) of the block dimensions, and $x_0$ is some function of the block dimension $t$. Assumptions 2 and 3 are based on the results of experiments on blast crushing of rock blocks and scarifying blasts [1]. The shape parameter of the Weibull distribution can be considered accurately constant in some range of the linear block dimensions and other initial data (Fig. 1).

The truncation of the Weibull distribution does not cause an appreciable change in the shape parameter with respect to the experimental curve (Fig. 2). Assumption 1 can be omitted if we introduce a new constant $\alpha$ determining the fraction of the initial blocks in the rock subjected to blasting fracture, $0 \leq \alpha \leq 1$. This assumption corresponds to the presence of clearly marked zones of blast crushing in the jointed rock without allowance for the effects of secondary crushing during movement and flight of the rock mass. In this case the expression for the resultant density (1) takes the form

$$f(x) = \alpha \int_{x}^{\infty} f_1(t) r(t, x) \, dt + (1 - \alpha) f_1(x).$$
In general we have a bimodal density (Fig. 3). The first peak is due to the predominant fraction of the fragments, and the second to the residual block jointing in the rubble.

The mean fragment dimension is

\[
\bar{x} = \int_0^\infty x f(x) \, dx,
\]

and by (3)

\[
\bar{x} = \alpha \int_x^\infty f_1(t) r(t, x) \, dt dx + (1 - \alpha) \bar{x}_1,
\]

where \( \bar{x}_1 \) is the mean dimension of the natural jointing.

Neglect of the transitional zone between the result of the blast crushing and the unbroken part of the jointing is the cause of the two-term form of the expression for the average fragment (4). For intensive crushing of a large-block mass, the above expressions can be simplified. In this case, between the fragment dimension \( x \), the block dimension \( t \), and the scale parameter \( x_{\text{ref}} \) (which in some cases can be interpreted in the sense of an average [4]) there is the following relation, which holds good for all the blocks in the zone of crushing:

\[
x \leq t; \quad x_{\text{ref}} \ll t.
\]

As a result, the lower limit of integration for (3) can be fixed and put equal to \( x_m \), the minimum block dimension. The normalizing factor also vanishes, so that \( r(t, x) \) will be the density of the Weibull distribution with variable scale parameter. The expression for the mean fragment size (4) takes the form

\[
\bar{x} = \alpha \int_0^{x_m} f_1(t) r(t, x) \, dt dx + (1 - \alpha) \bar{x}_1.
\]

We can simplify this by using the uniform convergence of the integral.