

MINING GUIDE

D20 SUPPLEMENT TO RUN A MINE



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INTRODUCTION

This new edition replaces the old one, which was dedicated specifically for dwarves.

This game supplement works with the D20 system, so it is compatible with all those game systems that employ the D20 in their game mechanics. Also, it wants to answer the following question: What would happen if a group of adventurers decides to claim a portion of land to mine metals, gems and stones?

Also, I would like to thank all those players who already bought this supplement. They let it possible to improve the Mining Guide, which will expand and improve accross the time ...this is a constant work in progress.

Forewords

Wizards build magical laboratories, fund magic academies, erect towers and assemble wonderful libraries. All for the love of knowledge and power.

Clerics open mission in lands far away to spread the creed of their gods among those who still don't know it, they form enclaves to study mystic and theological secrets, or they become important members of their churches.

Thieves start their own guilds, may it be of thugs, beggars, smugglers and assassins.

Fighters form their own company of fortune selling their service as Condottieri, while those who believe in the code of chivalry find an occupation among the court of kings, becoming barons, counts and duchies.

Every character, once arisen to the status of a known and renowned hero or a merciless, hated and feared villain, may decide to expand his/her ambitions. It is about time to write their names in the books of history.

The goal of this game supplement is to provide the Game Master and the players the tools required to allow a group of greedy adventurers to exploit the richness hidden in the underground world.

The content is D20 system compatible, so the mechanics explained inside do not need any conversion.

The creation of a mine is made of three essential steps:

- 1) Finding and prospect an area to verify the presence of a deposit - *Chapter 2 – Mining Sites.*
- 2) Determining the category of mine product and by-product - *Chapter 3 – Mine Products.*
- 3) Determining the output of the deposit by rolling the ore quality - *Chapter 4 – Mining Output.*

PREPARE YOUR PICKS !!!



CHAPTER 1 – BASIC STEPS

Races

When we talk about mining, we usually hear about the dwarves. Yes, they embody the stereotype of mining race, but they are not the only ones.

Other races dwell and thrive underground thanks to mining activities, and they transform their mines in their home. Duergars and deep gnomes - or Svirfnebli - are just some example.

Orcs, goblins, kobolds and other races that dwell in depth of the surface, also dig tunnels and extract metals to forge weapons and wage their wars.

Other humanoids are enslaved and forced to work in dangerous mines...that is the price to pay when you fall in the wrong hands.

Or what if a necromancer raises his own undead to dig in an archeological site? He will require skeleton and zombies.

A total of 26 six humanoid races are included in this supplement, and they come with some numbers to figure out how much they can dig accordingly to the environment, and how much is their upkeep. The list is far from being exhaustive of course, and it can be expanded, but it is something to begin with at least.

Environment

Not all environment are optimal to start mining operations. The environment described in this supplement are Desert, Hill, Jungle, Mountain, Plain and Volcanic Land.

Each one of these environment possesses its specificities and therefore specific chances to contain mine products. Some environment possess ores that others do not. Some environment have higher chances to contain specific deposits of ores, while others have lesser chances or no chance at all.

Mine Products

I can mine almost everything, but not everything is worth to be mined. This statement is true if we consider a fantasy setting with a technological level that ranges from the Middle Age to the Renaissance. Metals like aluminum or lithium, did not have any purpose and therefore they are not considered mine products. We make an exception for radioactive materials because we confer them a value due to their exotic properties. We must not forget that in fantasy settings magic is real and thus wizards, sorcerers, witches and alchemists may be able to exploit the properties of these materials. We admit four categories of mine products and subsequently we attribute a list of mine products to each category.

Exotic Materials: coal, petroleum, radioactive materials.

Gemstones: ornamental, semi-precious, fancy, precious gemstones, gems, jewels.

Metals: lead, zinc, iron, tin, copper, silver, gold, platinum, mithral, adamantite.

Stones: granite, basalt, marble.

Mine's Lifespan & Ore quality

We will describe mine output and ore smelting. Ore deposits are not all the same because we will take into account the quality of the extracted ore. Quality of the extracted ore is variable, moreover every ore deposit has a limited lifespan and very few among them last for generations.

CHAPTER 2 – MINING SITES

As we previously told, we may mine any terrain, but we also told that not every terrain is profitable. For example, a mountain may contain any metal, stone or gemstone but, unless it is not a volcanic land, it almost impossible that it may contain basalt. The conclusion is that some terrains favor or exclude a specific mine product. In the paragraph below we present the terrains and their favored mine products. Subsequently we will discuss how to prospect the terrain by assuming that some terrains are easier to prospect than others.

List of Environments

For the sake of this supplement, we take into account the most common environment.

We assign to every environment a mine product that is present in that specific environment.

Deserts: contain lead, zinc, iron, copper, gold, silver; coal, petroleum and radio-active materials.

Hills: contain any metal except Mithril; granite and marble; all kind of gemstones; coal and radioactive materials.

Jungles: contain silver, gold and platinum; precious gemstones, gems, jewels and all exotic materials.

Mountains: contain almost any mine product, except coal and petroleum.

Plains: contain coal, petroleum and radio-active materials.

Volcanic Lands: contain granite, basalt, gems and jewels.

TABLE I.I - DEPOSITS & ENVIRONMENT

Mine Products	MOUNTAIN	DESERT	JUNGLE	HILL	PLAIN	VOLCANIC LAND
Lead	Y	Y	n/a	Y	n/a	n/a
Zinc	Y	Y	n/a	Y	n/a	n/a
Iron	Y	Y	n/a	Y	n/a	n/a
Tin	Y	n/a	n/a	Y	n/a	n/a
Copper	Y	Y	n/a	Y	n/a	n/a
Silver	Y	Y	Y	Y	n/a	n/a
Gold	Y	Y	Y	Y	n/a	n/a
Platinum	Y	n/a	Y	Y	n/a	n/a
Mithril	Y	n/a	n/a	n/a	n/a	n/a
Adamantine	Y	n/a	n/a	Y	n/a	n/a
Precious Gemstones	Y	n/a	Y	Y	n/a	n/a
Gems	Y	n/a	Y	Y	n/a	Y
Jewels	Y	n/a	Y	Y	n/a	Y
Basalt	Y	n/a	n/a	n/a	n/a	Y
Granite	Y	n/a	n/a	Y	n/a	Y
Marble	Y	n/a	n/a	Y	n/a	n/a
Coal	n/a	Y	Y	Y	Y	n/a
Petroleum	n/a	Y	Y	n/a	Y	n/a
Radio-active Mat.	Y	Y	Y	Y	Y	n/a

Table I.I shows what mine products every environment may contain. The only exception are the ornamental, semi-precious and fancy gemstones, these group of gemstones are not shown because

these mine products exist as by-products of basalt, granite, marble, coal, petroleum, copper and iron. We will see in *Chapter 3 – Mine Products* how it works.

If your party is looking for iron, then they should start prospecting environment like Deserts, Hills or Mountains, in order to increase the chance of finding what they are looking for.

Otherwise, if your party is looking for something in a Desert (or a desert like environment), then they should expect to find deposits of lead, zinc, copper, silver, gold, coal, petroleum or radioactive materials. Their discovery depends on how good they are at prospecting the terrain, provided (and not assured) that terrain contains an exploitable deposit.

Prospecting

Prospecting requires time and skill. Some environment require more time; some are easier to prospect while other are harder. The specific skill required to carry the prospecting out depends on the rule set you are employing in your game sessions. However almost every D20 system employ the concept of DC (difficulty class), skill and D20 rolls. What specific skill is required is up to the Game Master, however any skill related with nature, geology or mining profession will work fine. At Game Master's discretion, two prospectors engaged in prospecting a terrain may aid each other thus adding +2 to their skill check. The chance of finding a deposit for a given terrain, must take into account following parameters:

DC: The difficulty class of the skill check.

A successful skill check reveals if a chance to find a profitable deposit exist. The prospector knows if the skill check is, or is not, successful unless he rolls a natural one. A critical failure means the prospector believes that the terrain does not contain any deposit. If the skill check simply fail then the prospector is entitled to roll again the skill check and the DC drops by one point. At Game Master discretion a natural roll of 1 maybe interpreted by the prospector as the presence of a vast deposit, only to discover weeks later of digging that nothing valuable can be found underground.

Time Required: It is the time required to complete the prospection for a given terrain.

The time required is not the same for all environment. Prospecting a mountain takes more time than prospecting a plain. During this time, the prospector is employing all his energies and efforts to complete the prospection. If in the area wondering monsters are present, then it is a good idea to hire mercenaries to maintain the area safe. If external factors force the prospector to halt, then the prospecting have to start again from the beginning.

Surface Covered: It represents how much surface the prospector prospects at that given time.

Some terrains like deserts and plains allow prospecting wider surfaces while mountains and jungles, being rough terrains, allow prospecting of a smaller surface.

Chance of a deposit: The chance that an ore deposit is effectively present underground.

A successful skill check does not automatically marks the presence of a deposit. Every terrain has a specific chance of containing a deposit. In other words, if the skill check is successful but the chance of finding a deposit is not, then it means that the prospector had a fake reading and that he just found traces of ore, maybe carried there from elsewhere or for whatever reason. The prospector is aware that the finding is unfruitful.

PROSPECTING & ENVIRONMENT

Environment	MOUNTAIN	DESERT	JUNGLE	HILL	PLAIN	VOLCANIC LAND
DC	15	20	25	15	12	18
Time Required	1 week	1 week	2 weeks	1 week	2 weeks	1 week
Surface Covered	1 x 1	4 x 4	2 x 2	2 x 2	6 x 6	2 x 2
Chance of a Deposit	30%	10%	15%	30%	25%	35%

Once the prospection is complete and the chance of finding a deposit is positive, we can determine what mine product we can mine. Finding a deposit is a dangerous task requiring weeks if not months. Another example of the dwarves' proverbial patience.

CHAPTER 3 – MINE PRODUCTS

In this chapter, we explain how to determine what mine products are present in the deposit. Four categories of mine products exist, but before rolling dices, let us spend some words to detail the nature and the purpose of each mine product.

To extract mine products like metals and gemstones we have to dig a variable amount of feet underground before reaching the deposit. Read *Chapter 5 – Digging* for more details.

SUMMARY: metals, gemstones, stones and exotic materials

METALS	GEMSTONES	STONES	EXOTIC MATERIALS
Lead	Ornamental**	Basalt*	Coal*
Zinc	Semi-Precious**	Granite*	Petroleum*
Iron*	Fancy**	Marble*	Radio-active Materials*
Tin	Precious		
Copper*	Gems		
Silver	Jewels		
Gold			
Platinum			
Mithril			
Adamantine			

*if a deposit contains one these mine products, then there is a chance that ornamental, semi-precious and fancy gemstones exist.

**deposits of iron, copper, granite, marble, coal, petroleum or radioactive materials contain these gemstones.

In the paragraphs below a short description of every mine product is presented, divided into four categories: gemstones; metals; stones and exotic materials. After the description you will find the *Table 1.2 - Mine Products*, where it will be possible to roll what category is potentially present in the deposit. Keep in mind that if a mine product is not compatible with its environment, then the mine product won't be present at all, not matter if the prospection was a positive.

GEMSTONES

Gemstones are classified into six main groups, according to their value and rarity. These categories are usually employed by experts in gemstones as an official way to categorize gemstones. Also, role playing games like AD&D and D&D 5th edition, employ the same categorization.

Each group of gemstone shows the average value, expressed in gold pieces (gp), of the gemstones belonging to that specific category. The entry in parenthesis means that the gemstone is a by-product of that specific mine product. Ornamental, semi-precious and fancy gemstones are the only gemstones that can exist as by-product of a mine product. For example, the Lapis-Lazuli is an ornamental gemstone that is commonly found together with marble, while the Quartz Crystal is usually entrapped within deposits of basalt.

Ornamental Gemstones (10gp): Azurite (copper); Agate (granite, basalt); Blue Calcite, (petroleum); Hematite (iron); Lapis Lazuli (marble); Malachite (copper); Obsidian (basalt); Rhodocrosite (iron); Turquoise (copper).

Semi-precious Gemstones (50gp): Bloodstone (iron, granite); Carnelian (iron, granite); Chrysoprase (iron); Citrine (granite); Jasper (granite); Moonstone (granite); Onyx (granite, basalt); Quartz Crystal (basalt); Tourmaline (granite); Zircon (granite).

Fancy Gemstones (100gp): Alexandrite (iron); Amber (coal); Amethyst (basalt); Fluorite (granite, basalt); Jade (iron); Jet (coal).

PRECIOUS GEMSTONES (500gp)

Aquamarine; Blue Spinel; Peridot; Topaz.

GEMS (1,000gp)

Garnet; Jacinth; Opal; Red Spinel.

JEWELS (5,000gp)

Diamond; Emerald; Ruby; Sapphire.

METALS

All metals possess a practical value and a commercial value. In this paragraph, we analyze every metal and we will see what use they have under different points of view.

ADAMANTINE

In fantasy settings, adamantine is employed to create weapons, armors and golems. Its origin is controversial, however it is common knowledge that it has interstellar origin and it probably comes from meteor impacts. Adamantine is very rare, very powerful and very expensive.

If you do not like the tale of the interstellar origin, you may attribute its origin to divine powers. This metal appears in Greek mythology as the metal of the Gods. The God Hephaestus was the only one to know where to find this metal, and he was the only one to know how to work it to create weapons and armors. Many of the mythical objects the Gods donated to their mortal heroes came from Hephaestus's forge.

MITHRAL

Mithral is another metal that comes from fantasy literature and is often called mithral silver. Dwarves consider mithral the noblest metal to employ in metallurgy. It is extremely hard, strong

and most important of all, it is light. Thanks to its weight, it is excellent to create armors. Mithral is found deep underground; this implies that extracting mithral is very dangerous. Unearthing a deposit of mithral is at the same time a blessing and a curse.

PLATINUM

Platinum has a place in fantasy settings literature only. Dungeons and Dragons introduced this metal as a currency even more precious than gold. However, during the middle ages and beyond, platinum did not have any commercial or practical value. Even during the colonial age, it was considered a waste and many called this metal "dirty silver". We can assume that platinum is an ingredient for alchemical processes, or a key element for creating special alloy and magical items.

GOLD

Gold is the uncontested king of all metals. Nations wage wars to obtain gold. Possessing and controlling a gold mine moves the balance of power to your favor. Every race considers gold as precious as mithral, some even more. While mithral allows creating extraordinary weapons and armors, gold allows to buy almost everything, including the hand wielding the weapon.

Since civilization discovered the concept of currency, gold played the part of the protagonist. You employ gold to mint coins, to forge ingots and create jewels. Gold, in the form of ingots, is employed in important commercial transactions, where incorporating a high value in few space is essential. Kingdoms seal deals by employing gold.

SILVER

Silver is the little brother of gold, and silver was the replacement for gold when gold was scarce. Like gold, silver is employed to mint coins, forge ingots and create luxury objects.

Kingdoms accepted silver for domestic transactions and internal trade affairs. Silver was the most common coin employed to pay soldiers and artisans, or to buy big stock of raw materials.

COPPER

Copper introduced man in the first age of metal, the Copper Age, and shortly after it accompanied him to the Bronze Age. Copper is employed to mint coins for everyday use, and these coins were the currency of the lower classes. Copper became important to create bronze and brass alloys, both very useful because of their resistance to oxidation. Many naval parts employed brass and bronze.

TIN

Tin as such, has always had few uses in the middle age. However, bronze alloys requires tin, so extracting tin and finding new deposits was not an option. The Roman Empire invaded southern Britain to gain access to tin deposits. Tin is easy to work and repairing objects with this metal was a common technique.

IRON

Iron and warfare walk together. No civilization can hope to last very long on the scene without a safe access to iron. Iron is essential in the fabrication of steel, which allows creating high quality weapons, armors and tools. Iron has a high commercial and practical value, and thanks to its abundance, the price remains relatively stable.

LEAD

Romans employed lead to create water pipes, glasses, dishes and other mundane objects of practical value. British Empire employed lead to seal military rations of the Royal Navy. Lead is not a common metal, and it possesses some practical value. It is the cheapest metal among all.

STONES

This category include rocks usually employed to erect and decorate buildings. With granite being the most common, followed by basalt and then marble as the most precious. Granite and basalt usually forms due to tectonic and volcanic activity, while marble comes from sedimentary processes. That is why it is unusual that marbles and granite/basalt share the same group of gemstones as by-product.

GRANITE

This is the most common building material and very abundant. Granite deposits lies in rocky environment like mountains and hills. Granite offers a plenty of by-products like agate, bloodstone, carnelian, citrine, jasper, moonstone, onyx, tourmaline, zircon and fluorite and, in rare occasions, more than one by-product may be present. Granite also comes in different colors, depending probably by the minerals presents in the rocks; tonalities of white, yellos, pink, red, bronw and green are the most common.

BASALT

Basalt forms due to volcanic activity, so it is an igneous rock. It seems that basalt contains high concentration of ferrous metals that confers the stone a peculiar color. With proper and complex processes it could be possible to extract these ferrous metals from the rock. Basalt is an uncommon building material, very useful to build strong and long-lasting roads, bridge and fortresses.

MARBLE

Marble is a luxury raw material. Architect employs marble to cover buildings due to its precious texture and colors. Temples, statues and carved walls are made of marble. This stone, like granite, exist in different colors, with tonalities of black, pink, red being the most common. Marble is very sensible to acidic substances live vinegar, also, in proximity of marble deposits it possible to find exotic oozes that feed on this valuable stone.

EXOTIC MATERIALS

Exotic materials are mine products employed below their true potential, mainly due to lack of proper techniques and technologies. However these products were kown by the ancients, who made abundant use of their properties. In this uspplemt we present petroleum, coal and radioactive materials.

PETROLEUM

Greeks and Romans knew of its existence. Many Mediterranean cultures, especially the Greeks, wrote about regions of "black and fire" thinking of them as the gates leading to Hell. What they probably saw, was surface deposits burning. Petroleum is an incendiary material and pitch, derived from petroleum, is useful in naval construction. Also, it is employed in advanced warfare techniques, but its extraction is sometimes dangerous.

COAL

Coal is essential in advanced metallurgy and is known since the Neolithic. It then becomes essential during the Bronze Age, when the first bloomeries appeared. Without coal, production of steel would not be possible and neither getting temperatures high enough to produce some special alloys.

RADIOACTIVE MATERIALS

Radioactive materials are all of metallic origin. They are all poisonous and potentially lethal, especially if they are present in high concentration. We may assume that the renowned resistance of dwarves and duergar to poisons and magic, has been developed due to the presence of these metals. We also assume that, in a fantasy setting, wizards and sorcerers employ radioactive materials to create powerful magical items or to fuel with magic power exotic and unknown forms of spellcasting.

DETERMINE MINE PRODUCTS

Roll a D100 and refer to table 1.2 to determine which mine product is present in the deposit, provided the prospector's skill check is successful and the chance of a deposit is positive. If the roll results in a mine product that is not compatible with the environment - Desert, Hill, Jungle, Mountain, Plain or Volcanic Land - as described in the *Summary*, then it means the mine product is not present and the prospection was a fake reading.

TABLE 1.2 - MINE PRODUCTS

D100	MINE PRODUCT	Refer to
01-65	Stones	see Table 2.1
65-83	Metals	see Table 3.1
84-93	Exotic Materials	see Table 4.1
94-00	Gemstones	see Table 5.1

Dhumbar is prospecting a portion of volcanic land, hoping to find something valuable to mine and he is aware that the task is not going to be an easy one. He has been prospecting for a week so far, and he thinks he is close to discover something. The player rolls a D100 and scores a seven. The chance of a deposit is positive, because volcanic lands have a 35% chance to have a deposit. However, only few mine products may exist in this type of environment, so Dhumbar cannot be sure that he has really discovered something valuable. Volcanic land allows the presence of gemstones (gems and jewels), and stones (basalt and granite).

The player refers to table 1.2 to verify if the deposit is exploitable. He rolls a D100 and scores 54. The roll tells that stones are present, may be basalt or granite.

MINE PRODUCTS: STONES and By-products

If you rolled for stones on table 1.2, you must now determine what kind of stone may be present among granite, basalt and marble. Refer to table 7.1 to determine the specific stone's output. Roll a D100 and refer to table 2.1 to determine what stone is present in the deposit and subsequently roll again to determine if any by-product is present.

TABLE 2.1 - STONES

DI00	STONES	Stones by-products
01-60	Granite	see Table 2.2
61-90	Basalt	see Table 2.3
91-00	Marble	see Table 2.4

Dhumbar is very excited. He knows that the chance of finding a deposit are high. While his brother, uncle and cousin are securing the area, Dhumbar checks and rechecks that his finding is positive. He starts digging to verify that what he found on the surface, is also present underground. The player rolls a D100 and score 74. This is Dhumbar lucky day! Under the surface, no more than five feet below the surface, he spots a solid layer of basalt, now it is even possible that, together with the basalt, some valuable gemstones are present. Before giving the good news to his family, he decides to spend few more hours to analyze the samples of soil and verify if gemstones are present. If, for example, Dhumbar had scored 95, then the result according to table 2.1 would have been marble, but volcanic land do not contain marble, so all the efforts of the last weeks would have been a waste of time.

GRANITE's By-products

Roll a D100 and refer to table 2.2 to determine what by-product of granite is present in the deposit. If you score 96 or more roll two times to determine two by-products. Subsequently refer to table 7.4 to calculate the output of every single by-product.

TABLE 2.2 - GRANITE By-Products

DI00	GRANITE By-Product	Gemstone group
01-50	Nothing	
51-70	Agate	Ornamental
71-72	Bloodstone	Semi-precious
73-75	Carnelian	Semi-precious
76-78	Citrine	Semi-precious
79-81	Jasper	Semi-precious
82-84	Moonstone	Semi-precious
85-87	Onyx	Semi-precious
88-90	Tourmaline	Semi-precious
91-93	Zircon	Semi-precious
94-95	Fluorite	Semi-precious
96-00	Roll twice	

BASALT's By-products

Roll a D100 and refer to table 2.3 to determine what by-product of basalt is present in the deposit. If you score 96 or more roll two times to determine two by-products. Subsequently refer to table 7.4 to calculate the output of every single by-product.

TABLE 2.3 - BASALT By-Products

D100	BASALT By-Product	Gemstone group
01-50	Nothing	
51-62	Agate	Ornamental
63-75	Obsidian	Ornamental
76-85	Quartz	Semi-precious
86-90	Amethyst	Fancy
91-95	Fluorite	Fancy
96-00	Roll twice	

Dhumbar is getting very nervous. Finding gemstones in a basalt deposit is not something you see every day. Such a discovery would bring prestige and wealth to all the clan. He scratches the stone with his pick to analyze a sample. If gemstones are present, he should be able to spot small shining fragments. The player rolls a D100 and score 77. Dhumbar cannot contain his enthusiasm and screams of joy. He has found traces of quartz, a semi-precious gemstone. Concentration is high enough to confirm the presence of a vein inside the basalt deposit. Meanwhile, his scream attracts the attention of wondering monsters and now, his family members, will have to deal with them. If the dwarves survive the day, then the deposit of basalt and quartz will be theirs for the taking.

MARBLE's By-products

Roll a D100 and refer to table 2.3 to determine what by-product of marble is present in the deposit. If you score between 91 and 95 roll once on table 2.2 to determine one by-product. If you score more than 96 then roll twice on table 2.2 to determine two by-products.

TABLE 2.4 - MARBLE By-Products

D100	MARBLE By-Product	Gemstone group
01-50	Nothing	
51-90	Lapis Lazuli	Fancy
91-95	Roll once on table 2.2	
96-00	Roll twice on table 2.2	

MINE PRODUCTS: METALS and By-products

If you rolled for metals on table 1.2, you must now determine what kind of metal may be present among lead, zinc, iron, tin, copper, silver, gold, platinum, mithril or adamantine.

Roll a D100 and refer to table 3.1 to determine what metal is present in the deposit and subsequently roll again to determine if any by-product is present. Refer to table 6.1 to determine the specific metal's output.

Among metals, iron and copper only may contain a by-product. Before reaching the deposit, it is necessary to dig 10D20 x 10 feet underground. See table 7.5 to know the digging rates.

TABLE 3.1 - METALS

D100	METALS	Metals By-products
01-05	Lead	
06-10	Zinc	
11-60	Iron	see Table 3.2
61-70	Tin	
71-85	Copper	see Table 3.3
86-90	Silver	
91-95	Gold	
96-97	Platinum	
98-99	Mithril	
00	Adamantine	

IRON's By-products

Roll a D100 and refer to table 3.2 to determine what by-product of iron is present in the deposit. Subsequently refer to table 7.4 to calculate the output of every single by-product.

TABLE 3.2 - IRON By-products

D100	IRON By-product	Gemstone group
01-50	Nothing	
51-71	Hematite	Ornamental
72-87	Rhodochrosite	Ornamental
88-90	Bloodstone	Semi-precious
91-93	Carnelian	Semi-precious
94-96	Chrysopidate	Semi-precious
97-98	Alexandrite	Fancy
99-00	Jade	Fancy

COPPER's By-products

Roll a DI00 and refer to table 3.3 to determine what by-product of copper is present in the deposit. Subsequently refer to table 7.4 to calculate the output of every single by-product.

TABLE 3.3 - COPPER By-products

DI00	COPPER By-product	Gemstone group
01-50	Nothing	
61-66	Azurite	Ornamental
67-82	Malachite	Ornamental
83-00	Turquoise	Ornamental

MINE PRODUCTS: EXOTIC MATERIALS and By-products

If you rolled for exotic materials on table 1.2, you must now determine what kind of exotic materials may be present among coal, petroleum and radio-active materials.

Roll a DI00 and refer to table 4.1 to determine what exotic material is present in the deposit. Refer to table 7.2 to determine the specific exotic material's output.

Coal and petroleum has a chance to contain amber, jet or blue calcite, see below for more details. Subsequently refer to table 7.4 to calculate the output of every single by-product.

TABLE 4.1 - EXOTIC MATERIALS

DI00	EXOTIC MATERIAL	Exotic Mat. by-product
01-60	Coal	see below*
61-90	Petroleum	see below*
91-00	Radio-active Materials	

*Coal has 50% chance to contain amber or jet.

*Petroleum has 50% chance to contain blue calcite.

MINE PRODUCTS: GEMSTONES

If you rolled for gemstones on table 1.2, you must now determine what kind of gemstones may be present among aquamarine, blue spinel, peridot, topaz, garnet, jacinth, opal, red spinel, sapphire, emerald, ruby and diamond.

Roll a DI00 and refer to table 5.1 to determine what gemstone is present in the deposit. Subsequently refer to table 7.3 to calculate the output of every single gemstone. Deposits of precious gemstones, gems and jewels do not contain any by-product. Before reaching the deposit, it is necessary to dig 10D20 x 10 feet underground. See table 7.5 to know the digging rates.

TABLE 5.1 - PRECIOUS GEMSTONES, GEMS & JEWELS

DI00	PREC. GEMSTONES GEMS & JEWELS	Gemstone Group
01-15	Aquamarine	Precious Gemstones
16-30	Blue Spinel	Precious Gemstones
31-45	Peridot	Precious Gemstones
46-60	Topaz	Precious Gemstones
61-68	Garnet	Gems
69-76	Jacinth	Gems
77-84	Opal	Gems
85-91	Red Spinel	Gems
92-94	Sapphire	Jewels
95-96	Emerald	Jewels
97-98	Ruby	Jewels
99-00	Diamond	Jewels

CHAPTER 4 – MINING OUTPUT

We have seen where we can search a deposit, the chance of finding a deposit in a given terrain and what a deposit can contain. Now we are going to determine the output of a deposit by rolling the mine product's quality.

Some deposits yield more than other does, because the mine products exist in higher and purer concentration. In addition, we have to determine the lifespan of a deposit, indeed some deposits run out in a matter of weeks or months, while other may last years, decades or even centuries.

We express the traits of a deposit as follows: Gp value, Time, Miner.

GP VALUE

Express the output of the deposit in terms of gp (gold pieces), without taking into account measure related to weight or volume. This applies to any deposit of stone, metal and exotic material, the only exception is deposit of gemstones where we express the output in terms of extracted units.

TIME

Express the amount of time required to extract a given gp. The amount of time required is expressed in weeks, so we employ the expression gp/week.

MINERS

The output depends on the number of miners working at the deposit. The more the miners assigned to the deposit, the higher is the weekly output of the deposit.

We express the output of the deposit as gp/week/miner.

LIFESPAN OF A MINE

Roll a D100 to calculate the lifespan of a deposit. The number obtained represents the lifespan of a deposit expressed in weeks. If you score double (11, 22, 33, etcetera) then roll again and add an equal amount of months. If you score a double again, roll once more and add an equal amount of years, then decades, centuries and so on. The only exceptions are the deposit of coal and petroleum, because both have an initial lifespan expressed in months and not weeks, but the double score rule still applies on the roll.

LIFESPAN MODIFIERS

ENVIRONMENT	MODIFIER
Mountain	Roll 3d10 instead of 2d10 when rolling for lifespan of any mine product
Desert	Roll 3d10 instead of 2d10 when rolling for lifespan of coal and petroleum
Jungle	Roll 3d10 instead of 2d10 when rolling for lifespan of any gemstones
Hill	Roll 3d10 instead of 2d10 when rolling for lifespan of any metal
Plain	Roll 3d10 instead of 2d10 when rolling for lifespan of coal
Volcanic Land	Roll 3d10 instead of 2d10 when rolling for lifespan of basalt

Dbumbar and his clan repelled the wondering monsters and secured the area. They know they will have to work hard to start exploiting the deposit and turn it into a prosperous and profitable mine. However they do not

know how long the deposit of basalt is going to last. The Game Master (secretly) rolls the lifespan of the mine. by rolling 1D100 and score a 33. A lucky roll indeed. The deposit will last at least 33 weeks, but having scored a double he is entitled to roll again to add the amount of months to the lifespan of the deposit.

If the deposit were located at a volcanic land, then the Game Master should have rolled three ten sided dice, or a D1000 in other words.

Having rolled as double, entitle the Game Master to roll a second time, to determine - this time - how many months, instead of weeks, to add to the deposit's lifespan.

The second roll score a 8, which translates into eight more months of lifespan or 32 weeks. so, the total deposit's lifespan is now 33 weeks plus 32 weeks, which is 65 weeks of lifespan.

Once the four dwarves start the mining activities they will reduce the lifespan of the deposit by 4 weeks for every week of extraction. The dwarves will deplete the mine in 16 weeks, more or less.

METALS OUTPUT

Once we have calculated the lifespan of the deposit, we can determine how much the deposit is going to yield by rolling the ore quality. Ore quality expresses how much the deposit yields in terms of gp/week/miner.

Roll a D12 and refer to table 6.1 to determine the ore quality of the deposit. The higher the roll, the higher the yield in gp/week/miner is. The gp value/week/miner expressed in table 6.1 represents the value of smelted ore. If ore is not smelted than the value expressed in table 6.1 is 25%. We will talk about smelters and ore smelting in the paragraph below.

Example: a copper deposit with ore quality of seven yields 21 gp/week/miner, provided the dwarves smelt the ore. If the dwarves do not smelt the ore then the deposit yields 25% of 21 gp, which is 5.25 gp (5 gp, 2 sp and 5 cp).

TABLE 6.1 - METALS OUTPUT

D12	I	2	3	4	5	6	7	8	9	10	11	12
Lead	1	2	3	4	5	6	7	8	9	10	11	12
Zinc	2	4	6	8	10	12	14	16	18	20	22	24
Iron	4	7	10	13	16	19	22	25	28	31	34	37
Tin	7	11	15	19	23	27	31	35	39	43	47	51
Copper	10	15	20	25	30	35	40	45	50	55	60	65
Silver	20	30	40	50	60	70	80	90	100	110	120	130
Gold	35	55	77	100	120	135	155	175	200	220	235	260
Platinum	80	130	177	225	275	320	370	420	465	560	610	660
Mithril	150	210	280	340	410	480	550	620	690	770	830	910
Adamantine	200	300	400	500	600	700	800	900	1000	1100	1200	1300

SMELTING THE ORE

Metal's ore requires smelting if they want to be turned into usable metal. We assume that every miner working at the mine smelt the ore thank to turn shift and organized work, so that smelting the ore does not affect how much the deposit yields. The amount of ore the miners smelt depends on the smelter, and different kind of smelter exist, each one with specific characteristics. Selling the ore without smelting it, reduces the value to 10% of what is shown in table 6.I, in other words the efficiency in absence of a smelter is 10%. Smelters range from the rudimentary forge, to the more complex furnace. Every smelter has specific characteristics, which are efficiency, capacity, cost, maintenance and tier.

Efficiency

Efficiency expresses how much ore is actually turned into usable metal, thus improving the value of the extracted ore. Efficiency is a percent value and, as we said, in absence of a smelter the efficiency is 25% by default. More efficient and more expensive smelters have higher efficiency.

Capacity

Capacity expresses the amount of ore the smelter can smelt in terms of week/miner. Larger and more expensive smelters can process the work of larger team of miners.

Cost

Smelters come in many size and forms, and they are expensive. The bigger they are, the more they cost, however they are more efficient and can process the work of more miners.

Maintenance

Keeping a smelter operational is expensive. Combustibles like coal, petroleum or wood are burnt to keep the temperature high, and keeping it clean is not an optional. The mining company must pay the maintenance on a weekly basis, and if they do not, the smelter will not be able to operate.

Tier

Tier represents the technological level of a smelter. Smelters have evolved with time, especially the smelters known as furnaces, which have been improved across the centuries. It is also plausible the mining company conducts research to improve their smelter, by improving one or more of its characteristics. At Game Master discretion, the mining company can improve a smelter; see the table *Technological Improvement* for more details.

SMELTERS IN HISTORY

As we said, we will consider two categories of smelters, the bloomery and the blast furnace. Bloomeries were the first piece of equipment ever employed to smelt ore into metal and has been used since the discovery of copper. Blast furnaces were an evolution that employed air fluxes to increased the heat inside the smelter.

BLOOMERY

Made of rocks and chalk, this primitive smelter works by combusting common and cheap materials. Miners can build a bloomery by scavenging raw materials in situ, so its cost expressed in coins is zero. It is not very efficient and can process the ore extracted by no more than 10 miner/week. Once built, it cannot be moved.

BLAST FURNACE

Blast furnace is an advanced smelter. It works with high potential combustible like coal, while air fluxes drasmatically increase the heat inside the chamber. Its principles works to this day and technology has increased efficiency dramatically. Blast furnaces have various prices, with different efficiency rates and capacity.

SMELTERS: Bloomery & Blast Furnaces

SMELTER's TYPE	Efficiency	Capacity	Cost	Maintenance	Size (squares)
Bloomery	20%	10 miners/wk	0 gp	0 gp/wk	M (1x1)
Blast Furnace tier I	30%	20 miners/wk	1,000 gp	50 gp/wk	M (2x2)
Blast Furnace tier II	35%	40 miners/wk	2,500 gp	125 gp/wk	M (2x2)
Blast Furnace tier III	40%	70 miners/wk	5,000 gp	250 gp/wk	L (3x3)
Blast Furnace tier IV	45%	120 miners/wk	8,000 gp	400 gp/wk	L (4x4)
Blast Furnace tier V	55%	250 miners/wk	15,000 gp	750 gp/wk	H (5x5)
Blast Furnace tier VI	65%	300 miners/wk	20,000 gp	800 gp/wk	H (6x6)
Blast Furnace tier VII	75%	360 miners/wk	30,000 gp	900 gp/wk	H (7x7)
Blast Furnace tier VIII	85%	430 miners/wk	35,000 gp	1,050 gp/wk	G (8x8)
Blast Furnace tier IX	95%	470 miners/wk	45,000 gp	1,350 gp/wk	G (9x9)
Blast Furnace tier X	100%	500 miners/wk	50,000 gp	1,500 gp/wk	G (10x10)

Tier: Expresses the technological level of the smelter. The bloomery is the lowest technological level and is always a tier 0 smelter. Blast furnaces represents a different approach of ore smelting, thus they possess various efficiency rates and capacity.

Efficiency: Express how much ore actually melts into metal. For example, a deposit of gold with ore quality 3 yields 50 gp/week/miner (see table 6.I). With no smelting the real value of the output is 100% of 50 gp, that is 5 gp. If I employ a bloomery, which has efficiency 20%, then the real value of the output increases to 20% of 50 gp, that is 10 gp. If I employ a tier I blast furnace, which has efficiency 30%, then the real value of the output increases to 30% of 50 gp, that is 15 gp.

Capacity: Express how much output the smelter can process in terms of week/miner. A bloomery can smelt the ore extracted by 10 week/miner, while a tier 4 blast furnace can smelt the ore extracted by 120 week/miner.

Maintenance: Express the cost for operating a smelter during one week. A bloomery has no cost of maintenance, because it works with scavenged materials. Sometimes it is more profitable to employ a bloomery instead of a blast furnace, especially if the deposit contains common ore of lesser value. In other words, you start the mine, you strip it, and then you go for another deposit.

Cost: Express the cost to buy a smelter. Of course, the cost applies only to blast furnaces; while bloomery do not cost a single gold piece.

PREPARING THE SMELTER

A smelter requires time to start operating, it has to be assembled and checked, so it takes one week per tier of the smelter before it can be put to work. A bloomery takes 1d6 days to be constructed.

TECHNOLOGICAL ENHANCEMENT

Technological enhancements apply to any trait of a smelter – efficiency, cost, capacity and maintenance – and only to blast furnaces. Enhancement does not apply to bloomery. Developing a technological enhancement takes time and resources, but its benefits will remain constant for long. A technological enhancement applies to a specific tier of blast furnace only, so if the mining company decides to enhance a tier 3 blast furnace, that enhancement applies to tier 3 blast furnaces only. To develop a technological enhancement we need to consider the following variables.

Required Time: Express the amount of time required to discover a technological enhancement. Roll Id4 and multiply it with the tier of the smelter, the result represents the number of months spent into research. At the end of this period, you are entitled to roll a skill check to confirm if the discovery is fruitful.

Cost of development: Developing a technological enhancement implies making experiments, consuming resources and researching new tools. Every month spent developing the enhancement costs $2d6 \times 100$ gp, in other words a variable amount of gp that range from 200 to 1,200 gp per month.

Difficulty Class (DC): Express how hard is to achieve a relevant technological enhancement. The DC to determine if the research is fruitful is 15 plus the tier of the smelter we are researching. The ability or skill check to employ should be knowledge (engineering) or any other similar ability.

SMELTER'S TECHNOLOGICAL ENHANCEMENTS

DIO	Efficiency (2)	Capacity (2)	Cost (3)	Maintenance (3)
1	+1%	-	-	-
2	-	+1	-	-
3	-	-	-	-5%
4	-	-	-5%	-
5	+2%	-	-	-
6	-	+2	-	-
7	-	-	-	-10%
8	-	-	-10%	-
9	+Id4 %	-	-	-
10	-	+Id4	-	-
11	+Id6 %	+Id4	-	-
12	+Id6 %	+Id4	-10%	-
13	+Id8%	+Id4	-10%	-10%
14	+Id10%	+Id6	-10%	-10%

Roll a D10 and refer to the technological enhancement table to determine the outcome of the research.

- (1) Add 1 to the D10 roll for every 5 point scored beyond the required DC.
- (2) Efficiency and Capacity cannot rise over twice their base value.
- (3) Cost and Maintenance cannot fall below half their base value.

STONES OUTPUT

Stones deposits follow the same rules for what concern the lifespan, however stones do not require any intermediate process like the smelting for metals, so their gp value is always at full value. Roll a D12 and refer to table 7.1 to determine the stone quality. The higher the roll, the higher the deposit yields in terms of gp /week/miner.

TABLE 7.1 - STONES OUTPUT

DI2	I	2	3	4	5	6	7	8	9	10	11	12
Granite	1	2	3	4	5	6	7	8	9	10	11	12
Basalt	2	4	6	8	10	12	14	16	18	20	22	24
Marble	4	8	16	32	36	40	44	48	52	56	60	64

Dbumbar and his family made their decision. They are going to exploit the deposit of basalt to the last drop. According to Dbumbar calculations, the deposit will yield around 6gp/week for every miner, and they will have to work hard to obtain a good income. The Game Master scored 8 when he rolled a D10 to determine the basalt quality. Indeed, table 7.1 states that quality 8 for basalt, means an income of 16 gp/week/miner. However, Dbumbar knows that quartz is present in the deposit, and quartz is more valuable than basalt. Quartz is a semi-precious stone, and semi-precious stones have an average value of 50 gp per unit. By rolling a D10 and referring to table 7.4, we determine how many quartz every miner is going to extract every week. The player (or the Game Master) rolled a 3, and according to table 7.4, the outcome is 1d8; it means that a miner will extract 1d8 quartz every week. Thanks to the presence of quartz, the mine will yield an average amount of 241 gp/ miner/week. We also said the deposit is going to last 65 weeks, so the dwarves are going to gain around 14,625 gp from quartz only, while basalt will yield around 1,040 gp. The first mining operation of Dbumbar's clan will make them rich enough to start the next mining operation with a conspicuous capital.

EXOTIC MATERIALS OUTPUT

Exotic materials deposits follow the same rules for what concern lifespan of the deposit, but exotic materials do not require any intermediate process, so their gp value is always at full value. Roll a D12 and refer to table 7.2 to determine the exotic material quality. The higher the roll, the higher the deposit yields in terms of gp/week/miner.

TABLE 7.2 - EXOTIC MATERIALS OUTPUT

DI2	I	2	3	4	5	6	7	8	9	10	11	12
Coal	2	4	6	8	10	12	14	16	18	20	22	24
Petroleum	5	8	11	14	17	21	24	27	30	33	36	39
Radio-active Mat.	9	13	17	21	25	29	33	37	41	45	49	63

Coal: extraction of coal does not require any specific technology; it is a matter of pick and shovel.

Petroleum: extraction of petroleum does not require any specific technology, it is a matter of diggin with pick and shovel, and gathering the oil with buckets.

PRECIOUS STONES, GEMS AND JEWELS OUTPUT

The output of this kind of deposit is not calculated like those of metals, stones and exotic materials, but is calculated in terms of gems extracted per week, no matter how many miners are working at the deposit.

Roll a D12 and refer to table 7.3 to determine the quality of the deposit, the higher the roll, the higher the number of gemstones extracted per week.

All gemstones extracted from a deposit are impure and have to be cleaned. This task is accomplished by master jewelers. An impure gemstone possesses 10% of the value listed in table 7.3. Cleaning a single gemstone, be it a precious stone, a gem or a jewel, requires a week of work of a specialized artisan.

TABLE 7.3 - PRECIOUS GEMSTONES, GEMS & JEWELS OUTPUT

DI2	I	2	3	4	5	6	7	8	9	10	11	12
Precious Gemstones	1d8	1d8+1	1d8+2	1d8+3	1d8+4	1d8+5	1d8+6	1d8+7	1d8+8	1d8+9	1d8+10	1d8+11
Gems	1d6	1d6+1	1d6+2	1d6+3	1d6+4	1d6+5	1d6+6	1d6+7	1d6+8	1d6+9	1d6+10	1d6+11
Jewels	1d4	1d4+1	1d4+2	1d4+3	1d4+4	1d4+5	1d4+6	1d4+7	1d4+8	1d4+9	1d4+10	1d4+11

Example: A deposit of opals (gem) with quality 4 (see table 7.3), yields 1d6+3 gems per week. The last the deposit yielded 6 opals. The gp value of a clean opal is 1,000 per piece (gems average value is 1,000 gp), but the opals has not been cleaned yet. If we sell the opals without cleaning them, the value is 10% per gem, that is 100 gp. If, among the miners, there is an artisan able to clean the gems, then he can clean the opals; the operation takes two weeks (one week for every opal) and their value is now 1,000 gp each.

BY-PRODUCT's OUTPUT

Deposit of by-products - ornamental, semi-precious and fancy gemstones - has a lifespan that equals the lifespan of the main deposit. By-products do not require any cleaning so they have the full value; ornamental gemstones (10 gp), semi-precious gemstones (50 gp) and fancy gemstones (100 gp). We assume that every miner can clean this kind of gemstone.

Roll a D12 and refer to table 7.4 to determine how many pieces a single miner extracts per week. The higher the roll, the higher is the amount of gemstones extracted in terms of week/miner.

TABLE 7.4 - ORNAMENTAL, SEMI-PRECIOUS & FANCY GEMSTONE OUTPUT

DI2	I	2	3	4	5	6	7	8	9	10	11	12
Ornamental	1d8	1d8+1	1d10	1d10+1	1d12	2d6	2d6+1	2d6+2	2d6+3	2d6+4	2d6+5	2d6+6
Semi-precious	1d6	1d6+1	1d8	1d8+1	1d8+2	1d8+2	1d8+3	1d10+1	2d6+3	2d6+4	2d6+5	2d6+6
Fancy	1d4	1d4+1	1d6	1d6+1	1d6+2	1d8+1	1d8+2	1d8+3	1d8+1	1d10+1	1d10+2	1d12+1

CHAPTER 5 - DIGGING

In this chapter we discuss about the digging rate. Digging rates depends on the type of terrain, hard terrain or soft terrain. Digging a hard terrain is slower than digging a soft terrain. Furthermore, we introduce a quick tunnel generator to see how the vein develops while digging.

All the rules mentioned above do not apply to deposits of stone and exotic materials, indeed they apply to deposits of metals and gemstones. Stones and exotic materials do not develop veins, rather

they form beds and sediments. Coal and petroleum, due to the nature of their formation, form beds and wells deep underground. Metals and gemstones form complex veins at multiple layer below the ground, that is why we suggest to employ a tunnel generator.

Furthermore, if the deposit is composed of metals, gemstones (precious, gems and jewels), coal or petroleum, then the dwarves have to dig 10D20 x 10 feet before reaching the deposit.

DIGGING THE TUNNELS

We express the amount of material a miner can dig during a day of labor in cubic feet.

TABLE 7.5 - DIGGING RATE BY RACE & ENVIRONMENT (in cubic feet/day)

RACE	Mountain	Desert	Jungle	Hill	Plain	Volcanic	Upkeep	Discipline
Bugbear	300	600	450	360	600	300	5 cp	9
Deep Gnome	550	1100	825	660	1100	550	2 cp	15
Derro	400	800	600	480	800	400	3 cp	5
Drow	200	400	300	240	400	200	3 cp	16
Duergar	500	1000	750	600	1000	500	2 cp	14
Dwarf	450	900	675	540	900	450	2 cp	16
Giant	100 _{xHD}	200 _{xHD}	150 _{xHD}	120 _{xHD}	200 _{xHD}	100 _{xHD}	4 cp _{xHD}	11
Gnoll	250	500	375	300	500	250	5 cp	6
Gnome	300	600	450	360	600	300	1 cp	13
Goblin	360	720	540	430	720	360	1 cp	12
Grimlock	280	560	420	340	560	280	2 cp	13
Halfling	150	300	225	180	300	150	1 cp	14
Half-Ogre	400	800	600	480	800	400	8 cp	13
Hobgoblin	300	600	450	360	600	300	2 cp	15
Human	200	400	300	240	400	200	2 cp	12
Kobold	300	600	450	360	600	300	1 cp	9
Lizardfolk	150	300	225	180	300	150	2 cp	10
Minotaur	750	1500	1125	900	1500	750	9 cp	8
Ogre	700	1400	1050	840	1400	700	14 cp	7
Orc	300	600	450	360	600	300	3 cp	12
Orog	500	1000	750	600	1000	500	8 cp	13
Skeleton	100	200	150	120	200	100	nil	nil
Thri-Kreen	600	1200	900	720	1200	600	6 cp	13
Troglodyte	300	600	450	360	600	300	2 cp	11
Troll	800	1600	1200	960	1600	800	16 cp	6
Zombie	50	100	75	60	100	50	nil	nil

Refer to table 7.5 to determine the digging rate according to the race and environment.

A typical mine section is a 10 feet sided cube, which translates in 1,000 cubic feet. Use the digging rate to determine how much the miners are digging and to design your mine. However, you should adapt the section size to the miner size also. A medium sized humanoid requires a space that corresponds to a 10 feet sided cube, but a troll for example, which is a large humanoid, requires more. Larger than medium sized humanoid requires a section that is 5 feet higher then the standard cube, and 5 feet on each of their side.

Example: A dwarf (medium sized humanoid), requires the standard 10 feet sided cube (1,000 cubic feet), and a dwarf can dig 450 cubic feet in a day of work (mountain). It means that a single dwarf miner can dig 1,000 cubic feet (a standard section) in a bit more than two days.

However, an Ogre (large sized humanoid), requires at least a 15 feet sided cube (3,375 cubic feet), and an Ogre can dig 700 cubic feet in a day of work. It means that a single ogre miner can dig 3,375 cubic feet (a standard section) in a bit less than five days.

UPKEEP

Upkeep is the price, expressed in cp (copper pieces), to feed and pay the each miner, accordingly to its race.

DISCIPLINE

Discipline is used when pushing and speeding the digging activities up. It is possible for the mining company to push the miners to increase their efforts and thus increasing by 50% the production and the efficiency extraction. The increased extraction, due to increased production and efficiency, does not reduce the lifespan of the deposit. Roll 1d20 to check the discipline, if the roll is equal or lower than the discipline value, then the discipline check is successful. However, if the check is not successful, you will have to wait 2d4 weeks pushing again the extraction.

TUNNEL GENERATOR

In this paragraph we present a simple tunnel generator that employs tables and random roll of dices. The generator works with deposits of metals, gemstones and radio-active materials, but not with stones and exotic materials (with the exception of radio-active materials of course).

To generate tunnels follow these steps:

- 1) Roll randomly to determine the direction of the vein. North, South, East, West, North East, North West, South East, South West.
- 2) Roll randomly to determine the lenght of the vein. The lenght is expressed in square of 5 feet to ease the mapping. Once the miners reach the end of the tunnel, the vein may change directions or continue underground.
- 3) Roll randomly to determine the end of the vein. Even if the vein ends, it does not mean the deposit is depleted, it is possible that the miners have to dig to reach a deeper level of the deposit.

TABLE 7.6 - TUNNEL GENERATOR

D8	Direction	D8	Length	D8	End
1	North	1	1d4 sections	1	Roll Direction and Lenght (1)
2	South	2	1d6 sections	2	Ore chamber (2)
3	East	3	2d4 section	3	The vein descends (3)
4	West	4	3d6 sections	4	Roll direction (4)
5	North East	5	4d8 sections	5	The vein ascends (5)
6	South East	6	4d10 sections	6	Roll Direction and Lenght (1)
7	North West	7	5d12 sections	7	The vein ends (6)
8	South West	8	6d20 sections	8	The vein splits (7)

(1) If the roll result in a direction where the vein came from, then the vein ends and you have to dig 10D20 x 10 feet below to reach the lower layer of the deposit. Example, you are digging toward North East and the direction changes toward South West.

- (2) An ore chamber has variable sizes. The size of an ore chamber is 2d6 squares wide and 2d6 squares long. Once the miner dig the chamber roll again the direction and have the vein starts from a random position of the ore chamber. If you roll a double (1..1; 2...2; 3...3; etc..), then roll again the size of the ore chamber and multiply the 2d6 roll by ten.
- (3) The vein proceed 1d4 x 10 feet underground, once reached the point roll again length and direction.
- (4) The vein proceed in the same direction, roll again to determine length.
- (5) The vein proceed 1d4 x 10 feet toward the surface, once reached the point roll again length and direction.
- (6) The vein ends and you have to dig 10D20 x 10 feet to reach the deposit, once reached the point roll again length and direction.
- (7) The vein splits. Roll two times to determine length and direction of both the veins.

CHAPTER 6 – EQUIPMENT & MACHINERY

In this chapter, we present a list of three equipment, the Mechanic Mole, the Distiller and the Extractor - employed by mining companies to increase mine's productivity. Each equipment has specific purpose and its own field of application. An equipment requires crew to operate. Miners assigned to operate an equipment cannot work at the mining activities.

MECHANIC MOLE

This machinery is quite common among mining companies run by dwarves, duergars and gnomes. Once a mining company runs enough successful mining operations, it hoards enough coins to afford a mechanic mole. Some mining companies buy from third parties, because they need quick stuff to employ. Other mining companies, maybe those more proud or poorer, put their engineer and technician at work to create one. As a result, it is hard to find a mechanic mole that looks like another, because each creation bears the personal touch of its designer. The mechanic mole operates with muscular strength and requires a crew of four medium sized miners to function. The advantages of this machinery are numerous; the main one is to speed up the excavation and extraction of the mine products, thus allowing to quickly deplete vast deposits, in less time. Every day the mechanic mole digs two 10 feet sided cube and deplete 1 weeks of the deposit's lifespan. Furthermore it increases the efficiency by 5% of extracted mine products, thanks to its speed, power and precision. The mechanic mole works only on deposits of metal, gemstones and coal. The mechanic mole is not usually deposits that may contain gemstones, because its activity may jeopardize the quality of the gemstones; if a mechanic mole is employed in a deposit containing gemstones, then there is a 50% chance that any gemstone extracted - including by-products - is destroyed. Cost: 100,000 gp; DC 15 to create.

DISTILLER

The distiller is an equipment designed to treat and refine coal and petroleum. It is a young technology and few mining companies are able to employ it. A distiller can double the output in terms of gp value/week/miner of any deposit of coal and petroleum, without depleting the lifespan. It requires a crew of miners. Cost: 50,000 gp; DC 25 to create.

EXTRACTOR

The extractor was employed to dry out aquifers that accidentally surfaced during underground mining operations. Some aquifers were small enough to dry out in few days by employing buckets and hard work; other aquifers however were large and deep. Therefore, the first extractors were designed. Machines capable of drying out the largest aquifers in matter of days. When mining companies discovered the first deposits of petroleum, it did not take too much time to understand the implications; with few modifications, the extractor now could work to extract huge amount of petroleum. Employing an extractor increases the output of a deposit of petroleum by 2d4 times in terms of gp value/week/miner, and at the same time it reduces the lifespan of the deposit by the same amount. Cost: 75,000 gp; CD 20 to create.

STONE Oozes

This is not really a machinery, it is indeed a creature that is bred by some humanoids like orcs, goblin and kobolds. The stone ooze is an effective, but dangerous solution, to refine basalt. It seems that the stone ooze feed on basalt sediments and consume only the rocky part of it. Because basalt has a high concentration of ferrous metals, especially iron, the natural by-product of the stone ooze digestive activity is indeed iron, with some traces of titanium and aluminium. The metallic wastes left by the ooze, are of high quality and confer the iron special properties. The stone ooze may explain why orcs for example, prefer to build their stronghold close to waste lands and at the same time they have access to fresh iron ores. If your mining company is employing a stone ooze, it can automatically add iron as a by-product of basalt.

Cost: unknown; CD to create, n/a.

Note: Dealing with a stone ooze is a dangerous matter. There is a 1% chance every week that the ooze split to reproduce, and the newborn includes meat in its diet. If such is the case treat the stone ooze as a black pudding. Needless to say that the presence of a black pudding inside an active mine, represents a catastrophe.

CREATING EQUIPMENT

Buying equipment for mining operations is not always a matter of gold coins. Many mining companies are jealous of their projects and equipment, and they are not always in the mood of selling them. Sometimes a mining company agrees to cede an equipment by written agreement, asking in return a part of the profits coming from the mining operations, plus the price of the equipment itself. When a mining company eventually decides to sell an equipment to another company, it is because a strong alliances with strategic goals in the region subsists. Therefore, if a mining company wants to employ an equipment to improve their mining activities, then they will have to work hard and create one of their own. Creating a mechanic mole, a distiller or an extractor takes time, gold and skill. If a mining company does not have a talented engineer among its ranks, it will be a hard task to create one.

To create an equipment follow these steps:

- 1) Divide by two the cost of the equipment. The new value is the target value to complete the equipment.
- 2) Roll a proper skill check. The DC (difficulty class) of the skill check depends on the type of equipment you are creating – mechanic mole DC 15, distiller DC 25, and extractor DC 20. Any skill like knowledge (engineering) should work.
- 3) If the skill check is successful, then multiply the result of the skill check for the DC of the

equipment you are creating. This number represents the daily advancement in terms of gp. Once the advancement equals the target value, the equipment is complete. You can speed up the process by rolling the advancement every week. If the skill check fails, then the creation will not advance, but only 10% of the funds are wasted.

4) Subtract an amount of gold from your funds equal to the advancement, if the skill check is successful, or subtract 10% if the skill check fails.

Example: Dhumbar clan wants to build a mechanic mole (CD 15). A mechanic mole has a target value of 50,000 gp (half the cost of 100,000 gp). The only decent engineer in the clan is Thorak, cousin of Dhumbar. Thorak engineer skill bonus is +6, not so bad after all. Finally, after many days of preparations, Thorak is ready to start the construction of the mechanic mole. The first day Thorak roll a skill check of 16 (1d20+6), enough to exceed the DC 16, so the construction, for this day, is successful.

The advancement is equal to 16 (skill check) multiplied for DC 15, $16 \times 15 = 240$ gp. In one day, Thorak completed 250 gp of the 50,000 gp, or the target value, more or less 0.48% of the total. Thorak is going to finish the mechanic mole in 208 day, more or less 7 months.

CHAPTER 7 – RISKS & HAZARDS

Mining operations are profitable and dangerous at the same time. some races have a deep knowledge of the natural phenomenons that occur underground, and have learned to deal with them. Nevertheless, when the force of nature shakes the mines, it is not easy to get out unharmed. Below we describe some of the most common risks and hazards to face when you dig underground.

EARTHQUAKE

Digging underground means you inevitably modify the surrounding environment, thus creating the conditions for micro earthquakes and sudden collapses. Sometimes the tremor depends on the traits of a specific region; other times the mining activities trigger tremors capable of collapsing even the toughest tunnels.

Dwarves and Duergar resistance to adverse underground conditions, is the main reason they are considered the best miners ever existed. However, no matter how strong and indentured they are, they can be annihilated even in their own environment. A tremor may trap a team of miners inside a tunnel, leaving the dwarves isolated and without air.

Collapses caused by a tremor, halt mining activities and it takes days to restablish mining operations.

AQUIFERS

Deep underground, or few feet below the surface, hide aquifers, subterranean rivers, lakes, high-pressure water basins, and in some cases subterranean oceans. When these waters releases their strength, they tend to destroy everything on their path. When events like this occur, it is of primary importance to detain and reduce their magnitude, and if the worst happen, be ready to release the tunnels from the grasps of the waters. Small mining companies employ more traditional and cheaper methods like buckets and arms. Richer and more experienced mining companies employ extractors to dry out the water quickly. However, the presence of aquifers is not always a disaster. If the mining company is mining a very large deposit with a long lifespan, they take advantage of this to turn the aquifer into a cheap supply of freshwater.

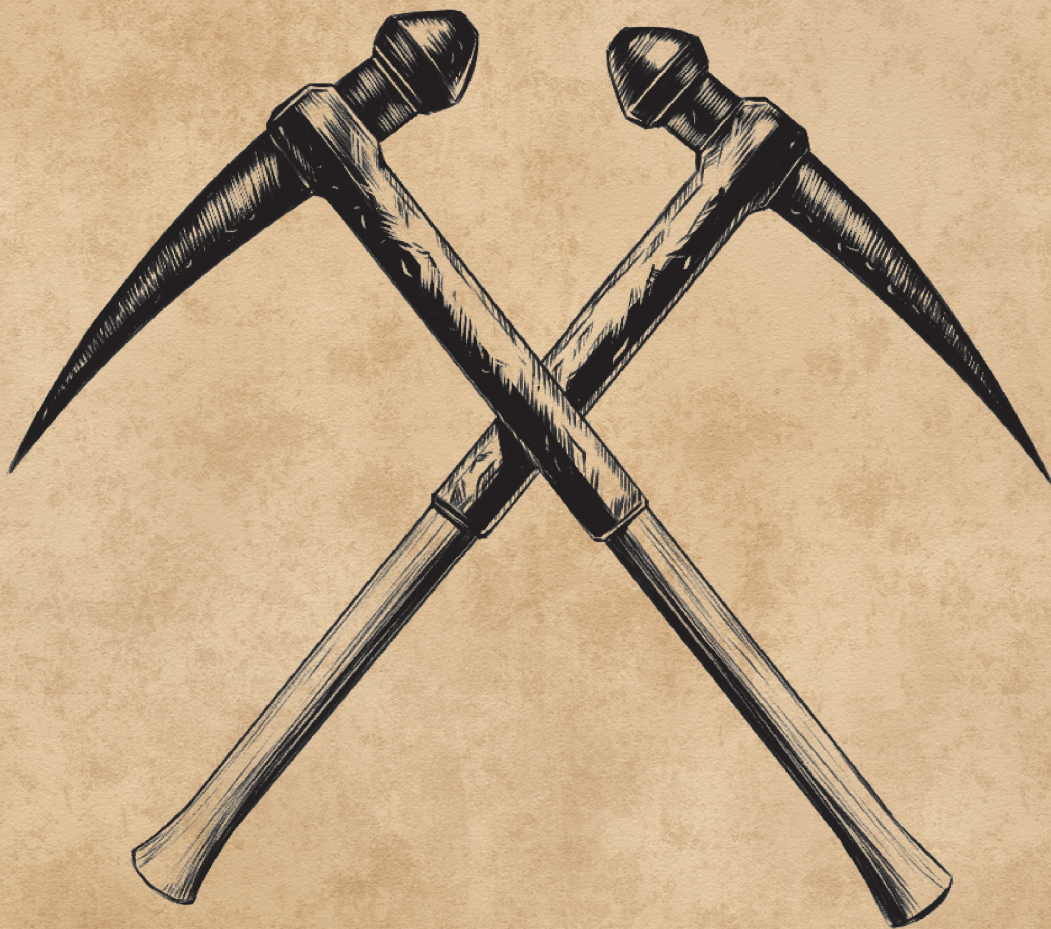
MINE GASES

Mine gases form underground due to traces of fossil fuels like coal and petroleum. Mine gas is highly explosive and inflammable. It detonates by accident and can incinerates team of miners, cause collapses or slowly choke the dwarves. Mine gases maybe present in every kind of underground deposit, especially in mines of coal, which always contains pockets of it. The only protection against mine gases is to detect their presence on time. An extractor is useful to mitigate the effects of these gases by employing the equipment to suck some pockets of mine gases out of the tunnels. Keep in mind that even a single spark may cause a disaster.

RADIOACTIVE GASES

Together with exotic materials like radioactive materials, radioactive gases exist also. Most of these gases are poisonous and odorless. Dwarves and duergar resistance to poisonous substances plays an important role, thus they can withstand these harmful effects more than any other race. Underground races other than dwarves and duergars know they have to coexist with it and pay the bill, and most of the time the bill is very expensive. However, despite dwarves and duergars resistance to poisons, extreme concentrations of radioactive gases are lethal for them also.

SEE YOU SOON WITH THE NEXT UPDATE !!!



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