Giants of Sampling 2: David W. Brunton

By Alan F. Rawle[1]

DOI: 10.62178/sst.002.006

1. Introduction

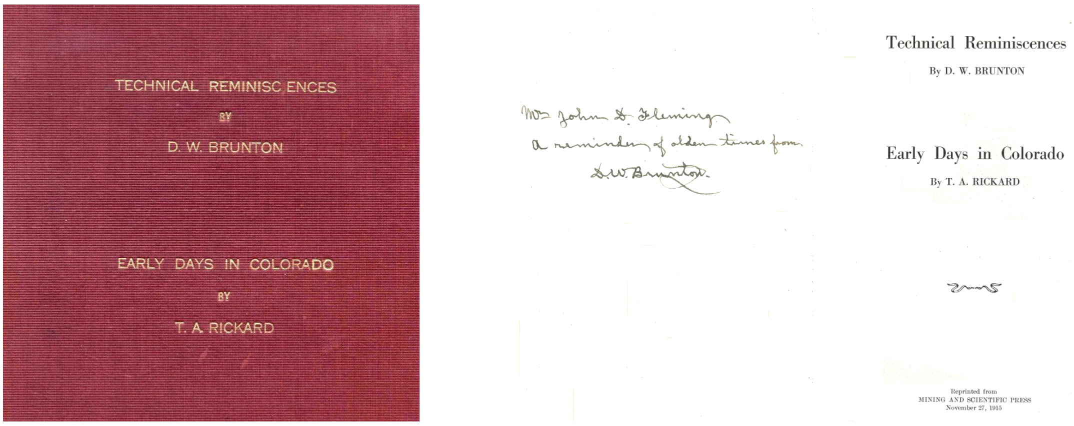
In contrast with Henry Vezin, of whom we wrote about in the last Sample Science and Technology, we have an enormous amount of information related to David (William) Brunton to draw upon. We have an extensive contribution from him in virtually every area of engineering and not simply in sampling science. He published and patented extensively and held positions of authority in the mining field. Brunton was President of the American Institute of Mining Engineers from 1909 - 1910 (and Vice President before that in 1897 – 1898). He was inducted (#181) into the National Mining Hall of Fane and Museum as late as 2004. We note, though, that Brunton was preceded by Georgius Agricola (Inductee # 180), author of De Re Metallica!

Brunton was interviewed by T A Rickard in 1921 in the Mining and Scientific Press in which many details of his early and scientific life were highlighted in the 13 pages of that article in a Question-and-Answer format. Another article written by Brunton entitled 'Technical Reminiscences', published in both the Mining and Scientific Press in 1915 and then reprinted in a small book of the same name, contains extensive details of the early pioneering days in the Colorado and Nevada mining fields (21 pages in prose format).

My copy of the latter with a dedication and signature from him is shown attached.

From these articles, we learn that Brunton was born in Ayr, Canada of Scottish parents in 1849 (June 11th) and came to the US in 1873 subsequently studying geology and chemistry at the University of Michigan in 1874 and 1875. There is a detailed autobiography written by Ginny Kilander in 'Enterprise & Innovation in the Pikes Peak Region' (Editor: Tim Blevins Pikes Peak Library District, 2011).

This excess of detailed career information relating to David Brunton means that we can only be selective in highlighting some of his achievements and inventions. Furthermore, Brunton made a fortune from an area unrelated to mining and sampling devices and that was his invention (and patent protection/defence of) of the pocket transit. He was also an expert witness in mining matters and an authority of the 'Law of the Apex', such legal dealings probably brought him significant income. His engineering skills lent themselves to car couplings, wooden mine beams, tunnelling, safety, and explosives in mining as well as several devices related to sampling of ores from a redesigned shovel and basic riffling devices to oscillating sampling devices dividing based on time.



Credit: Alan Rawle; used with permission.

Figure 1: Technical Reminiscences (AFR personal collection).

1 Retired. Hardwick, Massachusetts, USA.

Even a new design of circular slide rule was part of his skills. We'll deal with the ancillary parts first and then move onto Brunton's extensive contributions in the sampling field.

2. Car adventures

The extent of David Brunton's diverse engineering skills is displayed with relation to his purchase of the first automobile licensed in Denver, Colorado. This was no simple matter like buying a car today. In 1898, David Brunton travelled to Boston and went to an automobile show at Mechanics Institute and tested several motor cars. His selection was shipped to Denver in parts. A few months later in May 1899, Brunton noted in his diary: "May 7. Left Butte, reaching Denver on the 9th. Found Columbia electric automobile awaiting me. Spent day setting it up. May 10. Ran electric carriage on the streets in Denver." We note the early use of an electric vehicle! A picture is shown below of the 4 Brunton children going for a ride in a later car. I assume that this car was not assembled from parts.

It was not just fun and games for David Brunton and automobiles. From the Monthly Bulletins American Mining Congress Volume 13 Number 4 April 18th, 1910, we learn of the "Injury of D W Brunton".

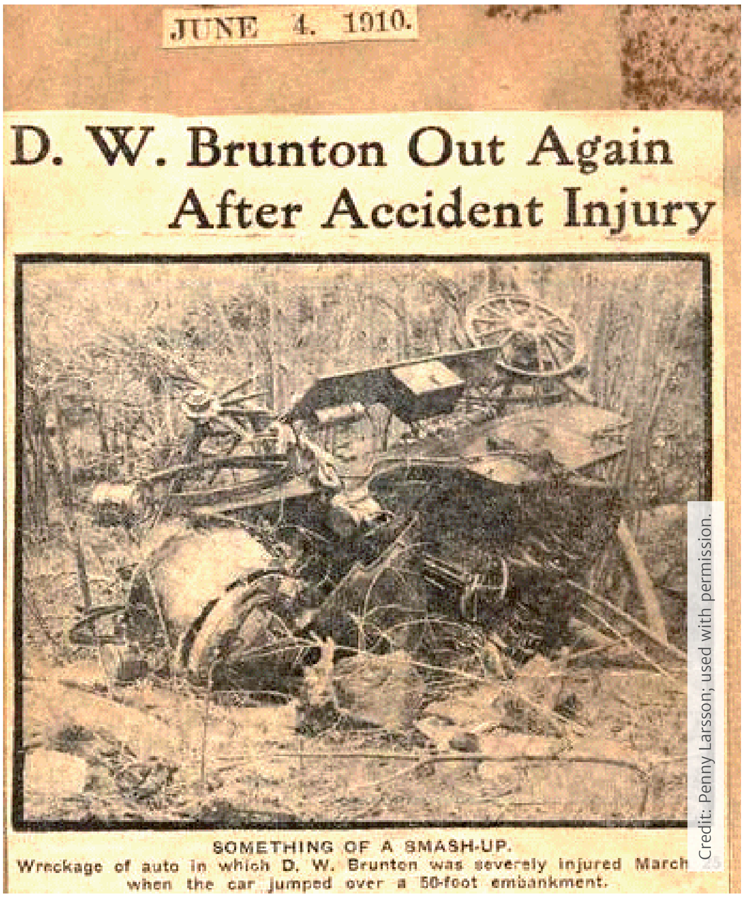
"A wide circle of friends were grieved to learn of the injuries sustained by Mr. David W. Brunton of Denver in an automobile accident on Monday morning, March 25, 1910. Mr. Brunton, in company with Mr. Wellington Hibbard and Mr. Aiken, officials of the Laramie-Poudre Reservoir & Irrigation Company, was on a tour of inspection of the company's works in the vicinity of Fort Collins, Colo., when the automobile in which they were riding got beyond the control of the driver on a steep grade. The machine, after a wild career down the road, overturned, throwing the Occupants out. All were injured, Mr. Hibbard dying shortly after. Mr. Brunton sustained severe injuries on the right side of his body, his right leg being badly lacerated. He was rushed to a hospital in Denver, where he is recuperating nicely.

The accident was most unfortunate, and while the death of Mr. Hibbard and the injury of Messrs. Brunton and Aiken is deplored, friends of the latter were very glad to learn that they were not more seriously injured".

Another newspaper article claims that the accident was as a result of the driver not slowing down when implored to do so by Brunton.

Figure 2: The Brunton children going for a ride in a later vehicle.

He had an earlier patent (1908) for a 'Safety lock for autos' and it was stated that his wife, Katharine Kemble, was the true car enthusiast in the family.


JUNE 4. 1910.

D. W. Brunton Out Again After Accident Injury

SOMETHING OF A SMASH-UP.
Wreckage of auto in which D. W. Brunton was severely injured March 25 when the car jumped over a 50-foot embankment.

Figure 3: The car after the "smash-up".

3. The pocket transit

This invention was the one that ensured a place in mining geology and military history for David Brunton. Prior to the invention of the 'pocket transit' mining engineers had to carry a large amount of unwieldy equipment to get basic information from a mine.

After experimentation and development, Brunton devised a portable (carried in the pocket) compass that would allow this basic information to be quickly obtained.

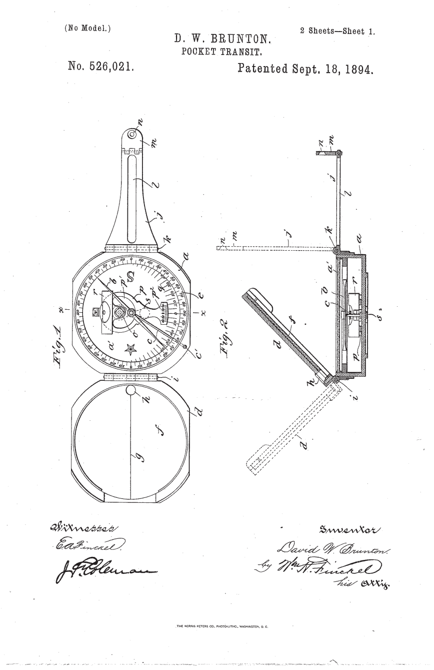


Figure 4: The Pocket transit first patent (1894) and early advertisement.

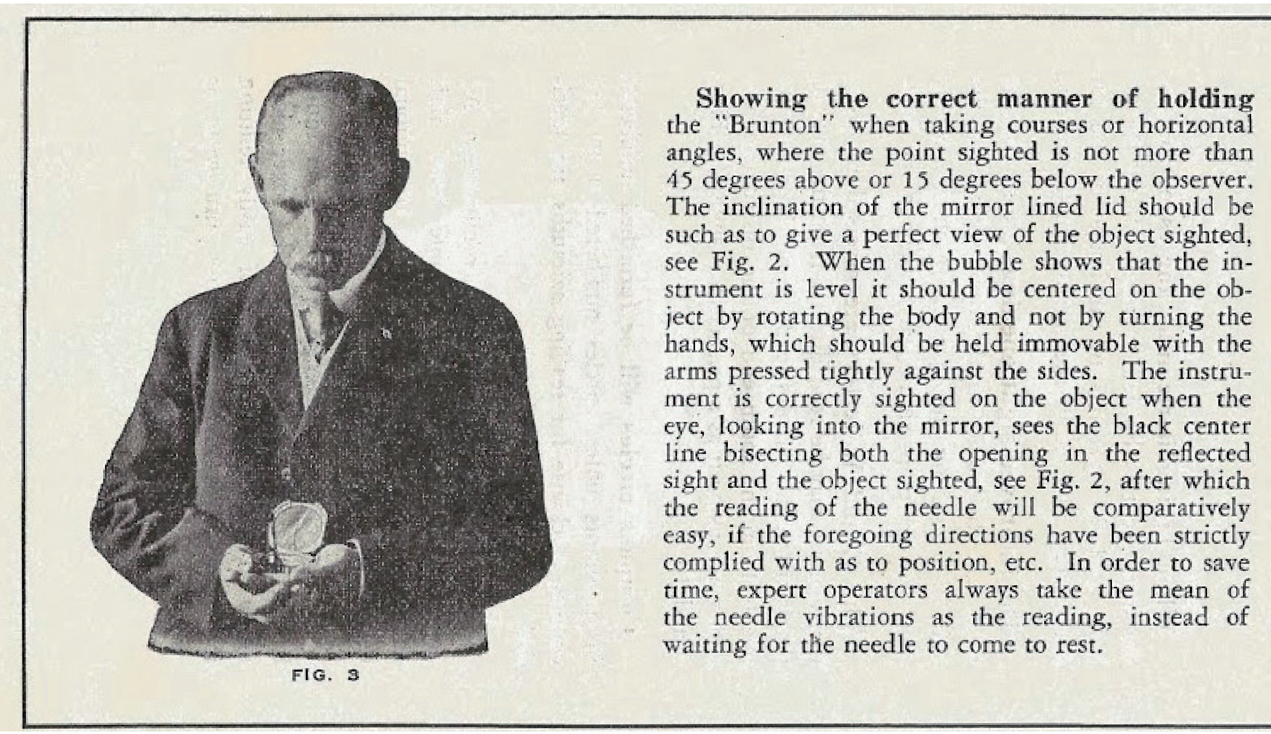


Figure 5: David Brunton using the transit (from the 1929 manual courtesy Brian Haren Northing & Easting | Making sure things are where they really are (oldtopographer.net)).

Credit: Brian Haren Northing & Easting; used with permission.

The advantage of the device was that it replaced bulky instruments. It has an accurate mirror compass, level and clinometer that reads in both degrees and percent of slope. The pocket transit could record the direction of a horizontal or vertical feature while also sighting the feature itself. With an enclosed spirit level, it could be used to measure the angles of dip and strike. He patented the initial design in 1894 (see below) but the device would have many iterations and upgrades over the years (e.g. degrees to 'mils' – dividing the circle into 6400 parts not 360 - for the US military version, the M2. This means that one mil is approximately 1000 of the radius of a circle and thus 1 mil at 1000 meters distance would mean a deflection of 1 meter, 2 mils – 2 meters etc. Gun pointing could then be carried out more quickly and effectively). Unusually, it was constructed from aluminium which was an expensive metal in those days. Many hundreds of thousands have since been sold since the early days.

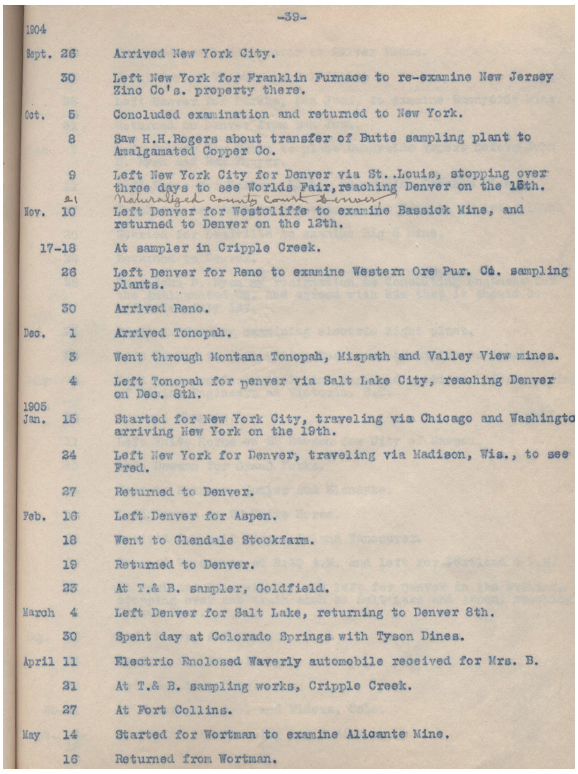
Interestingly, the opening of the patent states 'Be it known, that I, David W. Brunton, a subject of the Queen of Great Britain, but having declared my intention of being a citizen of the United States'. This was when he was still Canadian and finally naturalized on October 21st, 1904, in between trips to the World's Fair in St Louis and the Bassick mine in Westcliffe, Colorado. See the hand-written addition in (page 39 of) his diary entry below.

The first 2 or 3 transits were made by Negretti and Zamba in London in 1900 and 1901 but soon manufacture was switched to William Ainsworth and Son(s) in Denver. In 1972, following the closure of Ainsworth, manufacture was resumed in Riverton, Wyoming by the Brunton company formed specifically for that purpose.

4. Mine Tunnelling

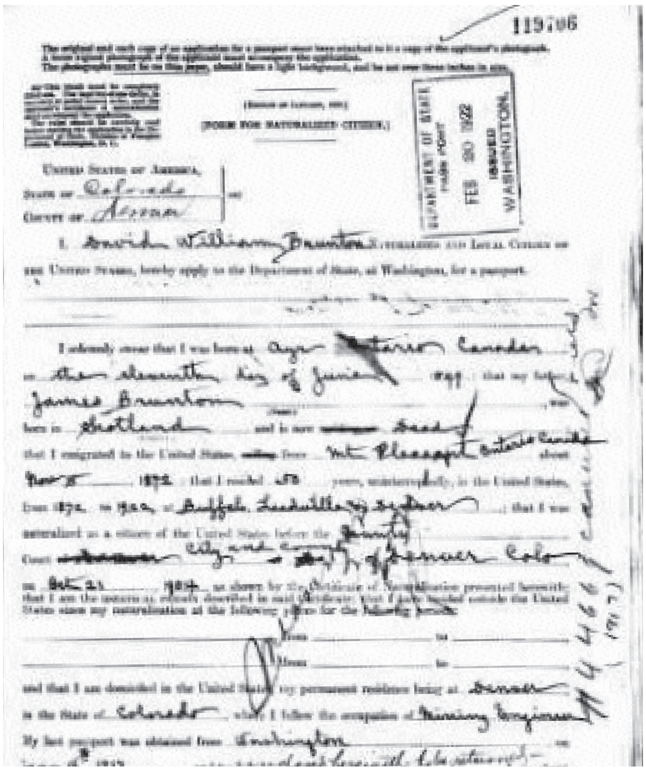
In 1914 Brunton published a government tome entitled 'Safety and Efficiency in Mine Tunneling', (United States Department of the Interior, Bureau of Mines, USBM Bulletin, B 57). In 1916, another document entitled Safety in Tunneling (Department of the interior, Bureau of Mines Miners' Circular 13) published with John A Davis contained the important maxim 'Don't shoot into explosives with a rifle or pistol, either in or out of a magazine'.

One of Brunton's most publicised successes was in the Cowenhoven tunnel (1893) which was: double-track, 2¼ miles long under Smuggler Mountain for Aspen Mines. It was drilled through water-saturated dolomite sand up to 421.5 feet/month (!). It led to the tunnel miners for presenting him with a "large gold medal" in "recognition of his arrangements for their comfort and safety".



-39-

1904		
Sept.	26	Arrived New York City.
	30	Left New York for Franklin Furnace to re-examine New Jersey Zinc Co's. property there.
Oct.	5	Concluded examination and returned to New York.
	8	Saw H.H.Rogers about transfer of Butte sampling plant to Amalgamated Copper Co.
	9	Left New York City for Denver via St..Louis, stopping over three days to see Worlds Fair, reaching Denver on the 15th.
	21	Naturalized County Court Denver
Nov.	10	Left Denver for Westcliffe to examine Bassick Mine, and returned to Denver on the 12th.
	17-18	At sampler in Cripple Creek.
	26	Left Denver for Reno to examine Western Ore Pur. Co. sampling plants.
	30	Arrived Reno.
Dec.	1	Arrived Tonopah.
	3	Went through Montana Tonopah, Mizpath and Valley View mines.
	4	Left Tonopah for Denver via Salt Lake City, reaching Denver on Dec. 8th.
1905 Jan.	15	Started for New York City, traveling via Chicago and Washington arriving New York on the 19th.
	24	Left New York for Denver, traveling via Madison, Wis., to see Fred.
	27	Returned to Denver.
Feb.	16	Left Denver for Aspen.
	18	Went to Glendale Stockfarm.
	19	Returned to Denver.
	23	At T.& B. sampler, Goldfield.
March	4	Left Denver for Salt Lake, returning to Denver 8th.
	30	Spent day at Colorado Springs with Tyson Dines.
April	11	Electric Enclosed Waverly automobile received for Mrs. B.
	21	At T.& B. sampling works, Cripple Creek.
	27	At Fort Collins.
May	14	Started for Wortman to examine Alicante Mine.
	16	Returned from Wortman.



119706

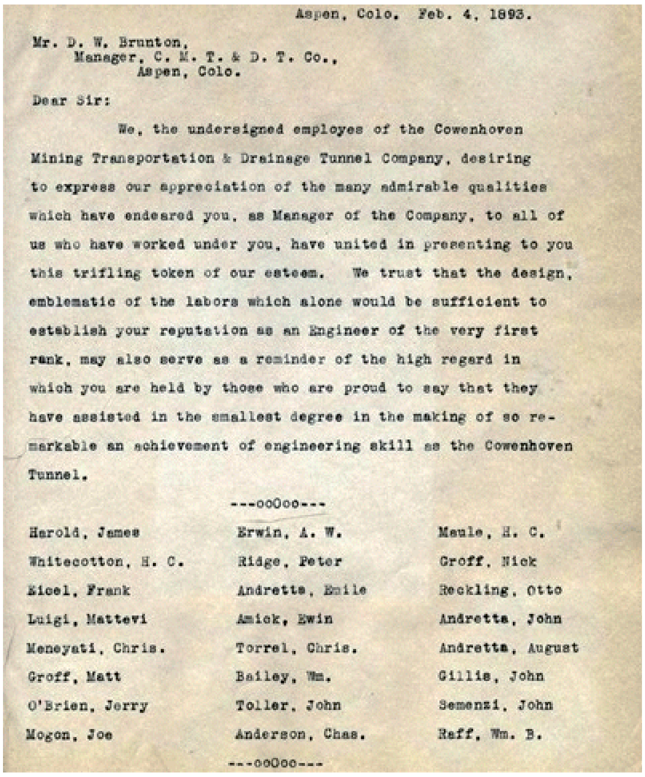
[FORM FOR NATURALIZED CITIZEN.]

United States of America,
State of Colorado
County of Denver

I, David William Brunton, a naturalized and loyal citizen of the United States, hereby apply to the Department of State, at Washington, for a passport.

Figure 6: Naturalization entry and 1922 passport application.

Credit: Penny Larsson; used with permission.



Aspen, Colo. Feb. 4, 1893.

Mr. D. W. Brunton,
Manager, C. M. T. & D. T. Co.,
Aspen, Colo.

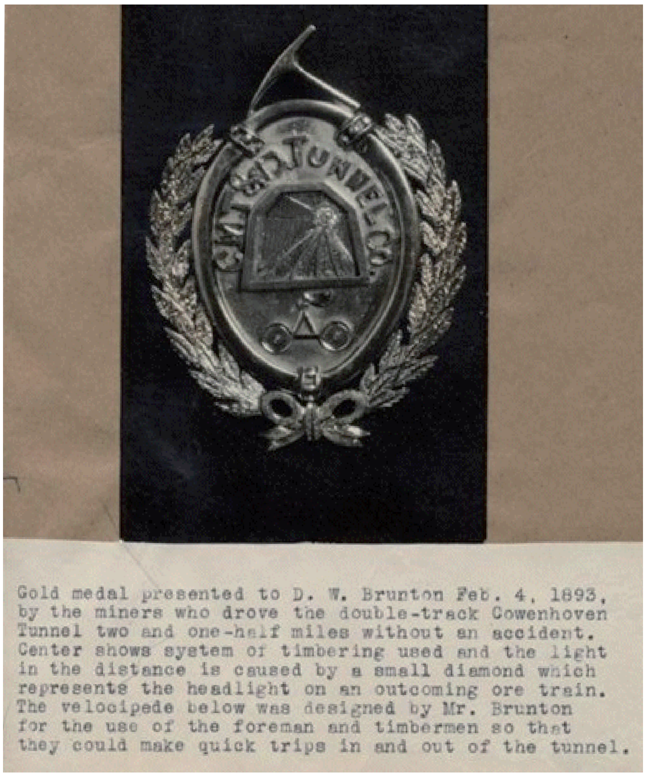
Dear Sir:

We, the undersigned employes of the Cowenhoven Mining Transportation & Drainage Tunnel Company, desiring to express our appreciation of the many admirable qualities which have endeared you, as Manager of the Company, to all of us who have worked under you, have united in presenting to you this trifling token of our esteem. We trust that the design, emblematic of the labors which alone would be sufficient to establish your reputation as an Engineer of the very first rank, may also serve as a reminder of the high regard in which you are held by those who are proud to say that they have assisted in the smallest degree in the making of so remarkable an achievement of engineering skill as the Cowenhoven Tunnel.

---ooOoo---

Harold, James	Erwin, A. W.	Meule, H. C.
Whitecotton, H. C.	Ridge, Peter	Groff, Nick
Eicel, Frank	Andretta, Emile	Reckling, Otto
Luigi, Mattevi	Amick, Ewin	Andretta, John
Meneyati, Chris.	Torrel, Chris.	Andretta, August
Groff, Matt	Bailey, Wm.	Gillis, John
O'Brien, Jerry	Toller, John	Semenzi, John
Mogon, Joe	Anderson, Chas.	Raff, Wm. B.

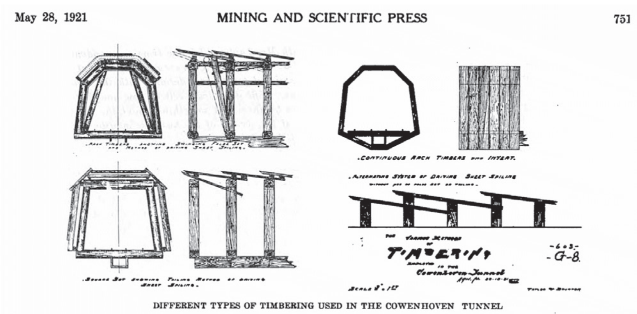
---ooOoo---



Credit: Penny Larsson; used with permission.

Figure 7: Letter and medal presented to David Brunton by miners of the Cowenhoven Tunnel.

There were a number of other innovations pertaining to the tunnel. One was in a bonus system instigated by Brunton where the miners received extra renumeration for all work in excess of 150 feet/month. Some machine drillers could then reach the lofty salary of 24 Pounds (strange as the $ was the currency of the US) per month. Because of the nature of the terrain new ways of supporting the tunnel with mine timbers were found. This led to patents US 692111 Mine-Timber January 28, 1902 and US759418 Mine Timber May 10, 1904 plus car couplings (US 515419 Car Couplings February 27, 1894).



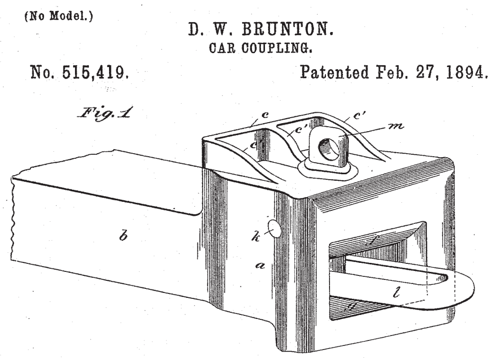


Figure 8: Mine Timbers and car coupling.

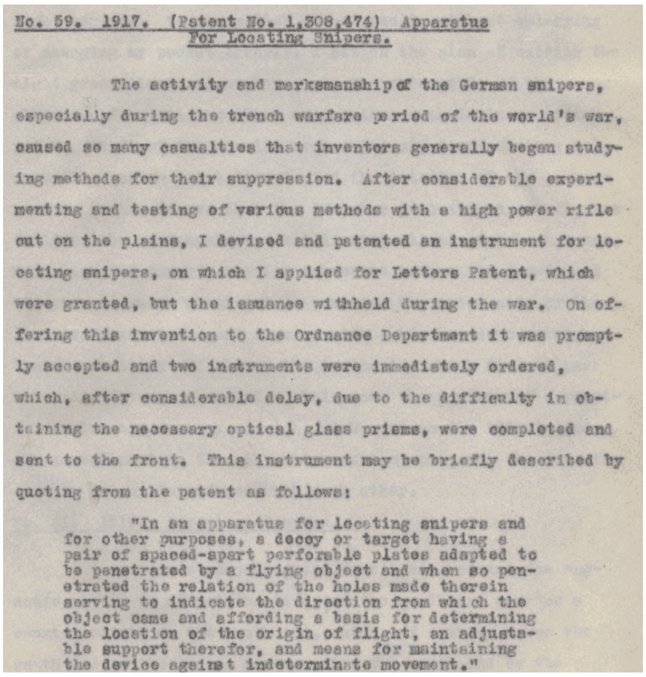
5. Mine mapping and the Law of the Apex

In the early days of mining, it was relatively easy to follow a find or vein until it potentially could (or did) venture under another property or claim. These issues led to the 'Law of the Apex' (or The General Mining Law of 1872 (as amended)). In broad terms, the law refers to the principle that title to a given tract of mineral land, with defined mining rights, goes to the individual who locates the surface covering the outcrop or apex. They had the right to mine the vein even if its subsurface extension continued beneath other mining claims. To prevent conflicts and resulting litigation, accurate mapping of mines was essential.

Brunton devised a method where various sections through the mine were displayed on (Vellum) tracing paper and placed one on top of another in a book. In this manner, the workings, faults, and ore bodies could be seen in relation to one another. Brunton used the approach successfully in court. He states in his 1921 interview with Rickard 'The best method of placing actual mine conditions before a judge or jury is by some graphic method of visualization. Verbal descriptions of mine workings convey little or nothing to a man who has never been underground'.

6. Work during World War 1

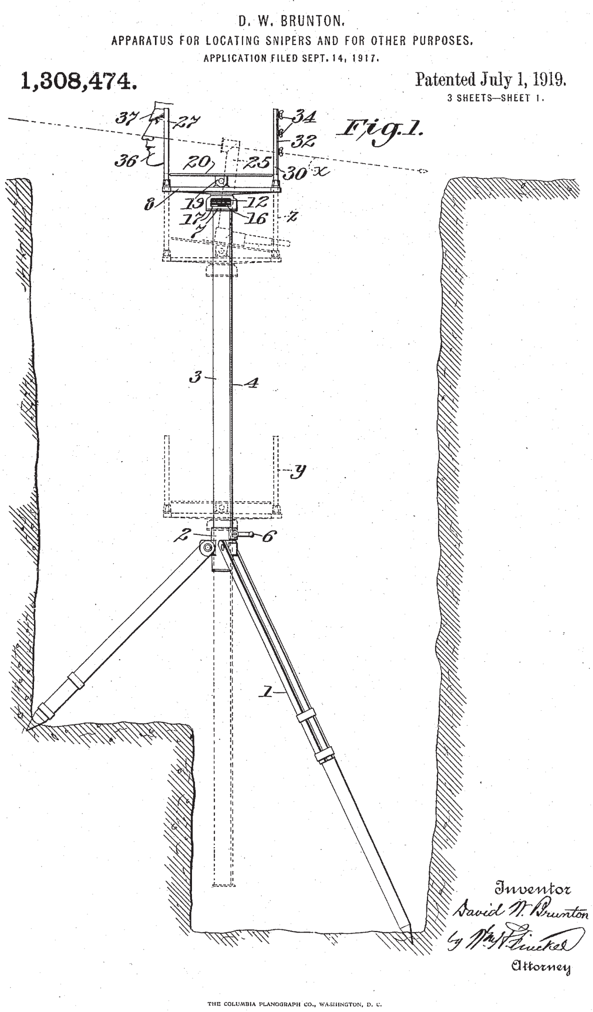
David Brunton represented AIME on the War Committee of Technical Societies first as a member and then as Chairman of that committee. Something like 135000 suggestions as to inventions that could help the war effort were made and these needed evaluation (most of them being useless). Brunton himself patented an idea for locating snipers. This remained classified until after the war.



No. 59. 1917. (Patent No. 1,308,474) Apparatus For Locating Snipers.

The activity and marksmanship of the German snipers, especially during the trench warfare period of the world's war, caused so many casualties that inventors generally began studying methods for their suppression. After considerable experimenting and testing of various methods with a high power rifle out on the plains, I devised and patented an instrument for locating snipers, on which I applied for Letters Patent, which were granted, but the issuance withheld during the war. On offering this invention to the Ordnance Department it was promptly accepted and two instruments were immediately ordered, which, after considerable delay, due to the difficulty in obtaining the necessary optical glass prisms, were completed and sent to the front. This instrument may be briefly described by quoting from the patent as follows:

"In an apparatus for locating snipers and for other purposes, a decoy or target having a pair of spaced-apart perforable plates adapted to be penetrated by a flying object and when so penetrated the relation of the holes made therein serving to indicate the direction from which the object came and affording a basis for determining the location of the origin of flight, an adjustable support therefor, and means for maintaining the device against indeterminate movement."



Credit: Penny Larsson; used with permission.

Figure 9: Brunton's notes on locating snipers and the published patent.

7. Sampling and samplers – theory and practice

Key (almost obligatory!) reference documents in this journey are:

- Ore-Sampling Conditions in the West (T R Woodbridge) Technical Paper 86 Department of the Interior Bureau of Mines (1916). Woodbridge worked at the Taylor and Brunton sampling works (of which we'll read more later) and this work contains a lot of really useful information, photographs, and pictures
- Mechanical Ore Sampling in Montana (H B Pulsifer) University of Montana Bulletin No 3 State School of Mines, Butte, Montana (March 1920). Lots of excellent diagrams and pictures of the early sampling days making much reference to the document immediately above. It does, however, have many excellent photographs of sampling devices and methods
- The 3 (classic) sampling papers in AIME published by Brunton:
    - A new system of ore sampling Trans AIME Volume 13 (actually XIII) 639 – 645 (1884)
    - The Theory and Practice of Ore-Sampling Trans. AIME Volume 25 (actually XXV) 826 – 844 (1895)
    - Modern Practice of Ore-Sampling Trans. AIME Volume 40 (actually XL) 567 – 596 (published 1910)

Also, we note than Geoff Lyman in his article (A brief history of sampling Aus IMM Bulletin, 39 – 45, June 2014) discussed Brunton at length so we'll try not to duplicate his (recommended) commentary which can be found as a free download on ResearchGate.

Brunton looked at all aspects of sampling from cone-and-quarter, through shovels, rifflers, and mechanical systems. Invariably he patented something related to each of those inventions. Further, this was not just theoretical work but employed in large scale sampling works in several very large mines in the west.

From a theory perspective, let's talk about Brunton's last 2 papers. The basic synopsis is that one particle added or subtracted would not make a difference to the "allowed" error and Brunton considered the addition of 1 particle of gold in 1/16 assay ton causing a 1% error in an ore running at $5200/ton. Other points:

- Used the cube as the reference shape, not the sphere. No description of the effect of shape or a shape factor
- The smaller the sample taken, then the finer the crushing needed
- Considered the maximum concentration of valuable ore in relation to the average grade
- The s.g. of the richest mineral (taken from Dana)
- 'The number of particles of richest mineral in excess or deficit'
- Dealt in tons and pounds.....and "screen cloth". No SI units or ISO/ASTM screen dimensions

In the 1895, paper Brunton displays a number of tables and graphical plots that are not easy to digest and there is not a single diagram or picture shown. It attempts to differentiate sampling for rich and lean ores based on the metallic content – something that still causes controversy today (the liberation factor in the Gy equations, for example). The 1909 paper contains some pictures (e.g. of cone and quartering and shovelling) and diagrams (e.g. sections taken by the Snyder, Vezin, and Brunton samplers) as well as detailed tables justifying the Brunton techniques of sampling. There are diagrams of the huge Taylor and Brunton samplers (more on this later) and flow charts of how huge ore deliveries are divided up: "The results of the investigations recorded in this paper show how absolutely necessary it is that ore-samples should be re-crushed after each successive "cutting-down," so that as the sample diminishes in weight, there may be a nearly constant ratio between the weight of the sample and that of the largest particle of ore contained therein"

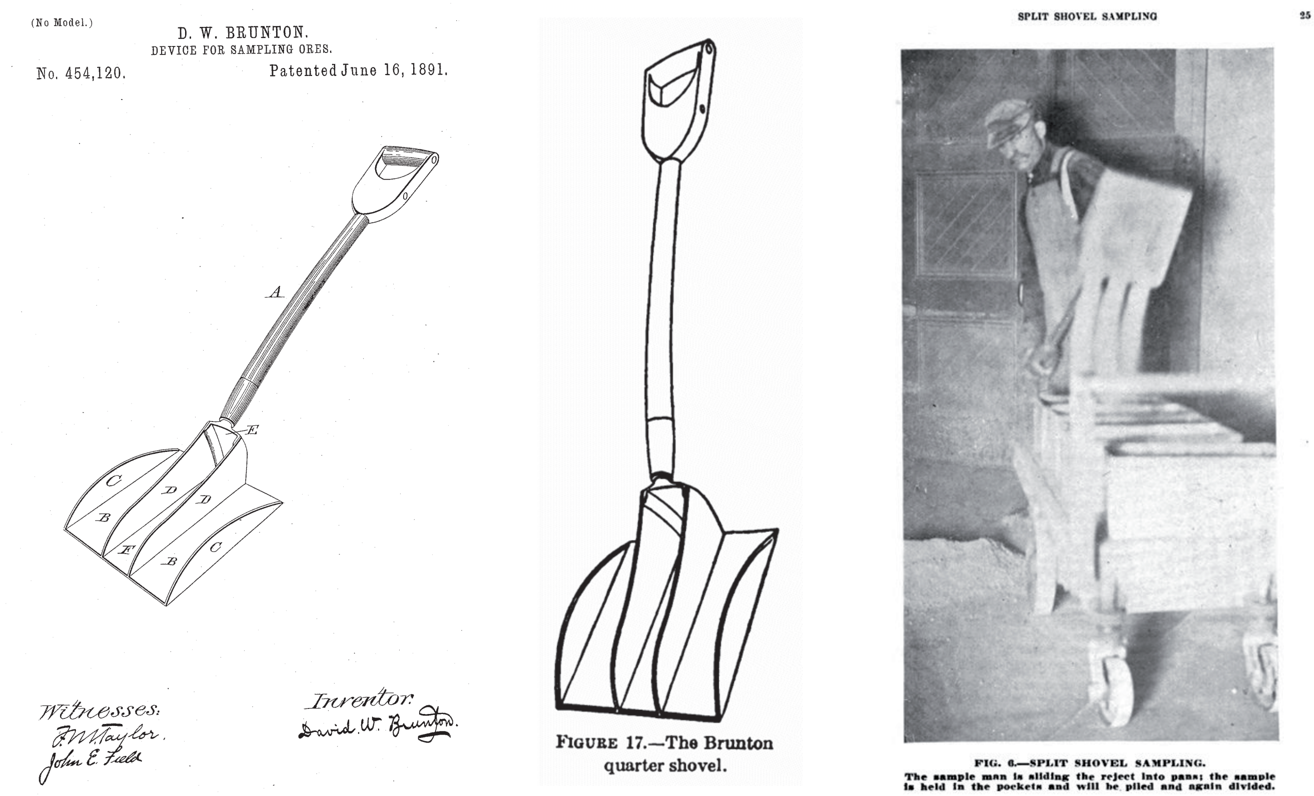


Figure 10: The 'simple' Brunton Shovel and its use (delimitation errors?).

8. Manual Division - The Brunton shovel

Shovelling (e.g. alternate shovels) has been a widely used method of sample division over the years and Brunton obviously thought carefully about the method and how to improve it.

There are actually 2 types of Brunton shovel. The simple 3 compartment (the centre one being half the volume of each of the outer 2 providing a quarter of the total in the centre) one patented in 1891.
The device works by shovelling in the normal manner and tilting the shovel backward in order to remove ¾'s of the total taken. The ¼ remaining in the centre compartment is then recovered by tilting the shovel forward into the appropriate lot. It appears to be a recipe for repetitive strain injuries! We can also see with segregated piles (always the case) that there's a tendency for the larger material to be retained in the outer compartments and the finer ore (probably richer) confined to the centre sampled compartment.

The 7-compartment shovel, with 3 sample and 4 reject divisions, may be used with higher-grade and smaller samples, and for original and duplicate samples.

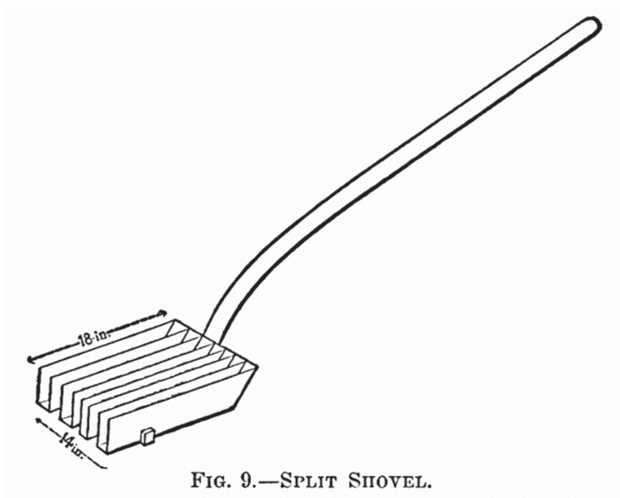


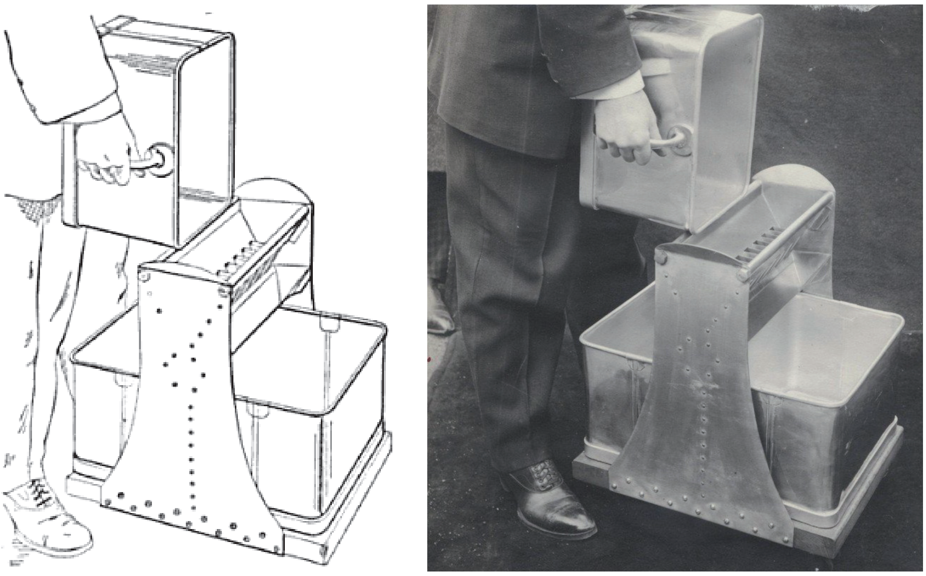
Figure 11: 7-compartment split shovel (from Hofman Metallurgy of Lead 1899).

9. Riffle divider

This is a slight improvement to the shovelling method and the cone and quarter method (for which Brunton had an attempt at mechanization – patent in 1896.

There are a number of similar photographs including one in the 1921 Interview article. This type of (non-rotary) sample divider still sees regular use.

It is important to note that the methodologies behind these huge constructions that we will describe have, in many instances, been forgotten by other industries. It seems ridiculous to talk to those in the pharmaceutical industry about needing shovelfuls of sample, but the problems related to the largest particles in the system hold true there as well as the mining industry.



Credit: Penny Larsson; used with permission.

Figure 12: Diagram from Richards' Ore Dressing. Picture shows David Brunton's lower half including trousers/pants.

The basic concepts of sampling were well known and thought out by players such as Brunton and Vezin and were summarized in Warwick's Notes on Sampling (see Figure 13).

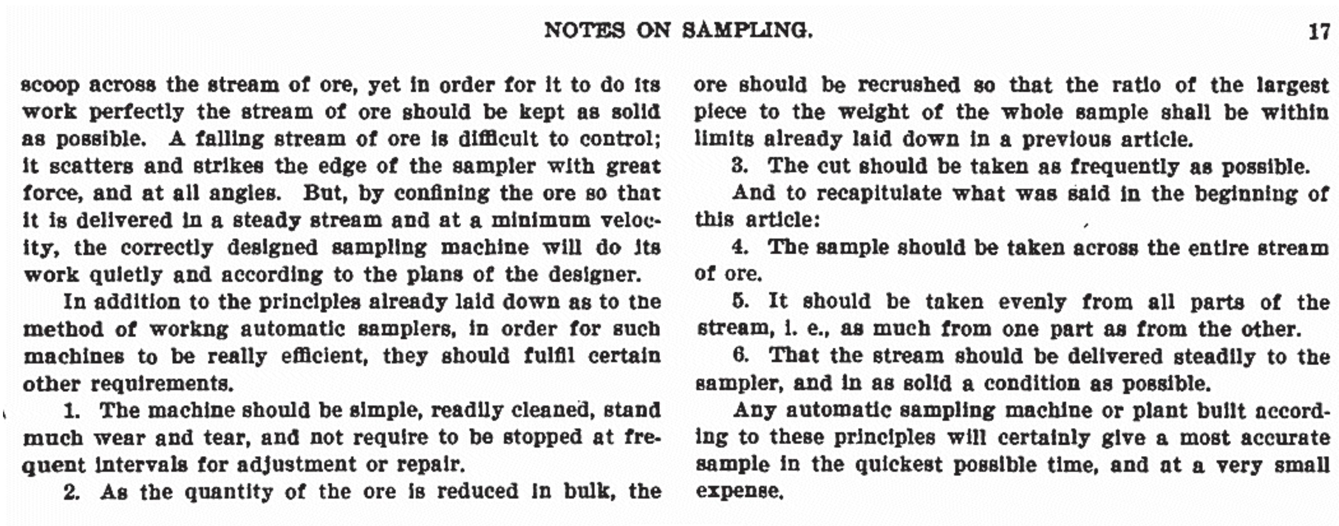
The fundamental constraint is 'The entire stream for a fractional portion of the time' and is the philosophy of Brunton's oscillating sample dividing on the basis of time. Several such dividers would be employed in the large sampling towers present in mines.

Brunton's oscillating sampler was shown in diagrams and pictures in his 1909 paper and those pictures are reproduced in Geoff Lyman's text. It was regarded as an improvement on his earlier vibrating method.

10. Mechanized routes of sample division

This probably is the zenith (or the apex?) of sample division and the practical outcome of years of thought and many (rejected) designs. I am remined of the comment by Warwick in 'Notes on Sampling': "But it is quite delusive to attempt to check a machine by a notoriously inaccurate method".

The oscillation is up to 72 times per minute and, typically, would sample in a representative 1/625 of the whole stream. This is from taking 4 portions each at 20% of the whole stream – $(1/5)^4$. Like most sampling devices it does not cope well with slurries or damp/sticky materials.



NOTES ON SAMPLING. 17

scoop across the stream of ore, yet in order for it to do its work perfectly the stream of ore should be kept as solid as possible. A falling stream of ore is difficult to control; it scatters and strikes the edge of the sampler with great force, and at all angles. But, by confining the ore so that it is delivered in a steady stream and at a minimum velocity, the correctly designed sampling machine will do its work quietly and according to the plans of the designer.

In addition to the principles already laid down as to the method of workng automatic samplers, in order for such machines to be really efficient, they should fulfil certain other requirements.

1. The machine should be simple, readily cleaned, stand much wear and tear, and not require to be stopped at frequent intervals for adjustment or repair.

2. As the quantity of the ore is reduced in bulk, the ore should be recrushed so that the ratio of the largest piece to the weight of the whole sample shall be within limits already laid down in a previous article.

3. The cut should be taken as frequently as possible.

And to recapitulate what was said in the beginning of this article:

4. The sample should be taken across the entire stream of ore.

5. It should be taken evenly from all parts of the stream, i. e., as much from one part as from the other.

6. That the stream should be delivered steadily to the sampler, and in as solid a condition as possible.

Any automatic sampling machine or plant built according to these principles will certainly give a most accurate sample in the quickest possible time, and at a very small expense.

Figure 13: Basic concepts for mechanized sampling (from Warwick).

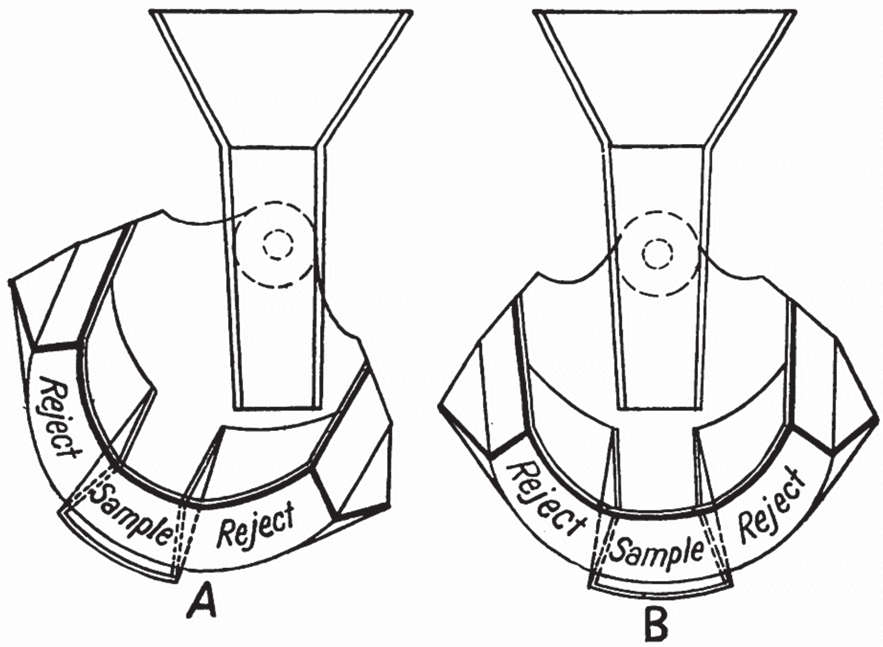


FIGURE 16.—Brunton oscillating time sampler. A, position of sample spout when ore is going to reject; B, position when ore is going to sample.

Figure 14: Brunton's oscillating time sampler (from Ore-Sampling Conditions in the West).

Brunton formed a partnership with Frank M Taylor and constructed 'Taylor and Brunton' sampling works all over the mines in the west of the US. Many close relatives of both Brunton and Taylor were employed within these works. W S Copeland was DWB's brother-in-law and was married to DWB's sister, Aggie E Brunton. WS managed the Aspen works and WS's brother, Lewis A managed the Utah works. Another brother of WS, George E, managed the Cripple Creek works. Tyler Woodbridge, to whom we have made extensive reference to his Ore-Sampling tome was "Tyler R. Woodbridge, Civil Engineer, care Taylor & Brunton Sampling Co., Victor, Colo".

This 4-storey building, making use of gravity, enabled a 1-ton sample from a rail cart to be automatically reduced down, via a number of comminution stages, to 8 ounces (a 99.84% reduction) and the remainder ('reject') loaded into delivery cars for further processing. This 8 ounces (~ 227 grams) lot sample is still almost 8 times larger than the standard 30-gram assay routinely employed in gold mines nowadays.

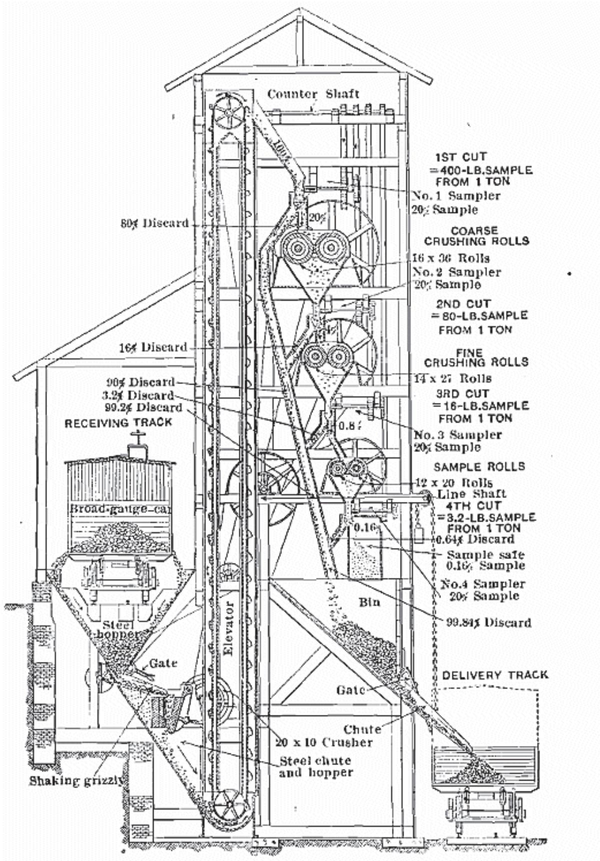


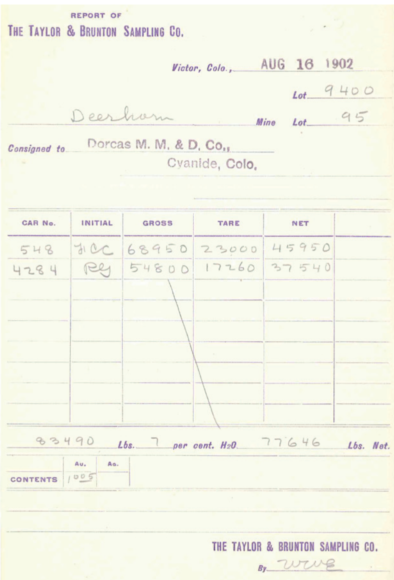
FIG. 15.—TAYLOR & BRUNTON SAMPLING-SYSTEM.

Figure 15: Diagram and the T & B sampling system (from Brunton's 1909 AIME Paper).

Figure 16: Taylor and Brunton Sampling Company – Cripple Creek district History Colorado. Accession # 90.156.384.

Customers submitted ore for analysis and were issues a simple report detailing the valuable metals (usually Au or Ag), moisture content (the buyer does not want to pay for water). Sometimes an analysis would simply state 'No gold'.

It's interesting to note that the importance of sampling was well-known in the late 1800's and early 1900's. One wonders if so much care and attention is employed now or whether "The work of sampling is often looked upon as within the realm of boys and pensioners only' (William Glenn AIME Volume XX "Sampling Ores Without Use of Machinery" page 155 (1892)) and 'It is perfectly evident, as Mr. Glenn says, that a vast amount of skill and precision is daily wasted by our chemists in the delicate analysis of samples that mean nothing' (Dr R W Raymond in the Discussion following the above article (quote spans pages 164 – 165)).



REPORT OF
THE TAYLOR & BRUNTON SAMPLING CO.

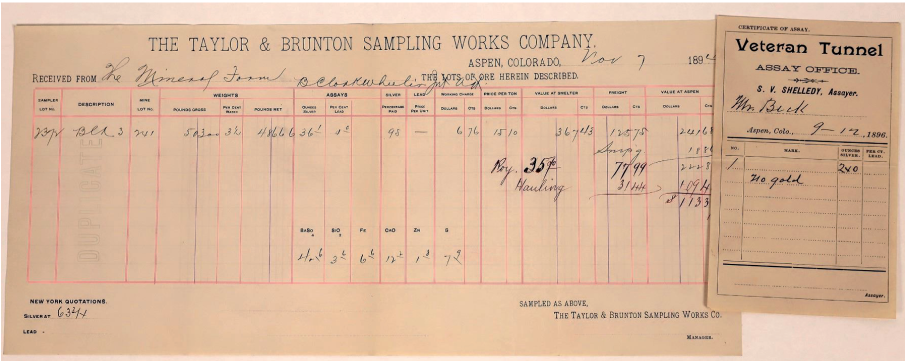
Victor, Colo., AUG 16 1902
Lot 9400
Deerhorn Mine Lot 95
Consigned to Dorcas M. M. & D. Co., Cyanide, Colo.

CAR No.	INITIAL	GROSS	TARE	NET
548	F.C.C	68950	23000	45950
4284	Ry	54800	17260	37540

83490 Lbs. 7 per cent. H_2O 77646 Lbs. Net.

CONTENTS Au. 1.05 Ag.

THE TAYLOR & BRUNTON SAMPLING CO.
By WWB



THE TAYLOR & BRUNTON SAMPLING WORKS COMPANY.
ASPEN, COLORADO, Nov 7 1894
RECEIVED FROM The Mines of Formn D Clark Wheeler Jnt Ad. THE LOTS OF ORE HEREIN DESCRIBED.

SAMPLER LOT No. | DESCRIPTION | MINE LOT No. | WEIGHTS: POUNDS GROSS, PER CENT WATER, POUNDS NET | ASSAYS: OUNCES SILVER, PER CENT LEAD | SILVER PERCENTAGE PAID | LEAD PRICE PER UNIT | WORKING CHARGE | PRICE PER TON | VALUE AT SMELTER | FREIGHT | VALUE AT ASPEN

DUPLICATE

BaSO4 4.6, SiO2 3.6, Fe 6.6, CaO 12.2, Zn 1.8, S 7.9

NEW YORK QUOTATIONS.
SILVER AT 63 3/4
LEAD

SAMPLED AS ABOVE,
THE TAYLOR & BRUNTON SAMPLING WORKS CO.
MANAGER.

CERTIFICATE OF ASSAY.
Veteran Tunnel
ASSAY OFFICE.
S. V. SHELLEDY, Assayer.
Mr. Beck
Aspen, Colo., 9-12, 1896.

NO.	MARK.	OUNCES SILVER.	PER CT. LEAD.
1	no gold	240	

Assayer.

Figure 17: Sampling Reports from the Taylor and Brunton Sampling Works.

11. Brunton's genealogy and heritage

Father: James Brunton (1820 - 1867)

- Born in Galashiels, Scotland (David Brunton states "Selkirk" in 1921 Mining and Scientific Press interview)
- 1820 to William Brunton and Ann Elizabeth Button
- Died: Aug 5th, 1867, in Ontario, Canada

Mother: Agnes Dickie (1824? - 1902)

- Born in Scotland (Kilmarnock) April 24 (?), 1824 to Thomas Dickie and Janet Halbert
- Died: Sep 4th, 1902, in Brantford, Ontario, Canada
- Year of birth probably incorrectly stated as 1833 in a number of texts

Spouse: Katharine Kemble Brunton (1865 - 1928)

- Mr. Brunton married, at Kingston, New York, February 11, 1885, "Miss Katharine Kemble, of that city. Mrs. Brunton is a lady of graceful accomplishments, and is descended from a distinguished colonial ancestry, one of whom was Colonel Johannis Snyder, one of the patriots of the American Revolution. Through his service, she is a member of the Daughters of the American Revolution"

Children:

- Fredric Kemble Brunton (1886 - 1929)
- John Teller Brunton (1892 - 1956)
- Harold James Brunton (1893 - 1941)
- Marion B. Brunton (April 26th, 1898)
  - Married Nelson Earle Barker (1892 - 1980)
  - Died: San Diego Mar 22nd, 1944)

In his 1909 AIME paper, Brunton stated 'The art of sampling has now reached a stage where a standardization of methods is both desirable and possible'. I'm not sure that this stage has been reached over 100 years later despite the pioneering work of David Brunton and others. As his legacy, we should simply quote a compatriot, W L Saunders of New York: "No one is more competent to discuss the modern conditions in mining and metallurgy than Mr. Brunton, for he not only speaks as one in authority, but his experience and his ability entitle him to a hearing as one of the first rank among mining engineers. The moral code set forth in the concluding paragraph of his paper is worthy to be placed as a classic in the annals of the Institute, and it should form the basis of instruction to mining engineers at the colleges". (In the Discussion following the reading of David Brunton's paper "Modern Progress in Mining and Metallurgy in the Western United States" Trans. AIME, Volume XL, 543-561, (1910). Same volume as the "Modern practice of ore-sampling" 567-596).

ACKNOWLEDGEMENT

David Brunton was a keeper of detailed notes and much of this has been retained in various locations. When I first embarked on this journey for a webinar given in December 2012 (sadly no longer available), I had the considerably fortune to become acquainted with Penny Larsson. Penny was the great-granddaughter of DWB, on her mother's side). She provided access to a huge amount of information that she made available from her personal collection of DWB's photo albums, scrapbooks, diaries, and books and some of which she documented on ancestry.com (she allowed me access to this site too). I have been unable to reconnect to her (I guess she'd be in her 80's now), but her generosity and kindness enabled a superb presentation to be constructed with those personal touches unavailable elsewhere. I have used some of the material within this paper and I gratefully and humbly acknowledge her contribution.