to it. In this case it is quite likely that the stone in question had been thrown there by someone who had found it out in a field, but of that possibility I cannot be certain. In any event, the specimen represents a completely new find. No other meteorite has been reported from any point nearer than about 50 miles, and this stone is readily recognized as belonging to a different fall from even those nearest finds.

I have several times picked up meteorites in the field which had evidently never been discovered by anyone else; usually, however, these finds were made in areas where I knew there had been a fall, and I was out for the express purpose of finding additional individuals of the known shower. I recall picking up a beautiful individual of the Beardsley, Kansas, fall of 1929 October 15. I found my stone in 1932. I have picked up also several stones of the Holbrook, Arizona, shower of 1912 July 19, some 20 years after the fall occurred. One of these stones was a very fine specimen of about 1000 grams. Moreover, while near the village of Xiquipilco, Mexico State, Mexico, I spied a small iron projecting a few millimeters from the ground and recovered a specimen of about 2 pounds. At the Odessa, Texas, Meteorite Crater, several irons were picked up by me and other members of my family without the aid of instruments of any kind. On 2 occasions in my 20 years of meteorite collecting I have come across meteorites in *rock gardens!* In both instances the specimens discovered represent previously unknown falls; in one instance, the find was a specimen of 6¼ pounds, and in the other, it consisted of 3 small stones that had been set in the top of a cement wall along with other decorative pebbles! Five of the Plainview, Texas, stones were discovered and collected by me from the soil, while a sixth one was sighted under the road-side fence as I drove by. I have kept no record of the number of Canyon Diablo, Arizona, irons that I have picked up in the field without the aid of instruments, or of the number of oxidized pallasites (meteorodes) from the Brenham Township, Kiowa County, Kansas, field. The number, in each case, must run close to a thousand. Of course, the largest number of meteorites collected directly from the soil, with which I have had anything to do, were recovered by means of a device that I have called a *magnetic rake.* With this instrument we have collected many thousands of small specimens near the Canyon Diablo (Barringer) Crater and from the rim of the Odessa Crater. We have collected a few small specimens likewise from the Plainview shower and at least one from the Holbrook shower, by aid of this device. We are looking forward to the time when conditions will again permit the pursuit of such activities as meteorite collecting!

Concerning the Meteor Observed on January 30, 1868, which Fell thru the Atmosphere as a Shower of Stones at Pultusk in the Kingdom of Poland

J. G. Galle [1812-1910]
Translated by Walter H. Haas

[*Continued from the November, 1942, Issue**]

The Reduction of Planetary Velocity and the Change of Motion Incident upon the so-called Bursting of the Meteor[ite]

If it is agreed that intercomparison of all observations heretofore discussed justifies the conclusion that the straight-line path thru the atmosphere, calculated

*C.S.R.M., **3**, 58; P. A., **50**, 509, 1942.

on the basis of the Danzig and Breslau observations, corresponds very closely to the true path, then we may proceed to consider the final question as to what influence the so-called bursting of the meteor[ite] and the scattering of the individual meteor[itic] stones had upon the direction of the path, which, up to now, has been regarded as rectilinear. Here the Danzig observation, according to which the meteor[ite] burst in the immediate vicinity of Sirius, supplies an unmistakable answer. If one calculates the azimuth of Sirius for the moment at which bursting occurred, one finds 313° 56′; if one calculates further the azimuth of the point of fall of the stones (assumed to be at 39° 3′ longitude from Ferro and 52° 45′ north latitude) as seen from Danzig, one has 313° 28′. The azimuth of the bursting point, 5½ miles above the Earth's surface, and that of the fall on the surface are, therefore, identical within ¼ of a mile. Therefore, the stones dropped nearly perpendicularly from the bursting point and retained only a small component of their initial forward motion. If the previous direction of motion, with an inclination of 44° to the horizontal plane, had continued, then they would have first reached the Earth's surface 5½ miles farther to the E.N.E.; or, if one wished to assume that the Danzig observation had placed the end point too far to the left, then, in order to satisfy the actual point of fall, one would have to set the error of observation at 9°, which may be described very well as quite inconceivably large.

Further Proof (thru Sound Observations) of the Vertical Descent of the Stones from the Bursting Point to the Earth

This vertical fall of the stones, from the bursting point on, finds still another very notable confirmation by the observation of the interval of time which elapsed from this luminous process up to the detonation, an interval which was observed exactly at Warsaw. According to Mr. Kowalezyk's report, this interval of time amounted to 3½ minutes. Likewise, Dr. Neugebauer reports the following about this sound phenomenon: "According to Mr. Deike's observation, the report which was heard after the meteor had vanished from sight followed the luminous appearance in 3½ minutes. The observation of an acquaintance of mine, the Director of the German Evangelical College at this place, Mr. v. Bäckmann, whose reliability is not open to doubt, appears to me to be especially valuable for your purpose in this connection. It consists of the following: at the instant when the meteor showed itself, Mr. v. Bäckmann was walking along on the western [one] of the two sidewalks of the street 'Krakau Suburb' (which runs from N.N.W. to S.S.E.) toward its southern extension, the so-called 'New World.' Astonished by the suddenly appearing bright illumination of the objects around him, the cause of which lay behind him, he quickly turned around in order to investigate the latter, and then he saw the fireball arise just above the western row of houses of the 'Krakau Suburb' and move along above the street, nearly in a northeastern direction, in a line slightly inclined to the Earth, growing more and more distant from him; finally, it was suddenly dispersed into a great quantity of spark-shaped, shining points of light above the eastern row of houses. He still looked for a couple of seconds toward the region where the phenomenon had occurred and thereafter continued on his way into the street 'New World.' Advancing with regularly measured strides and looking around again toward the region of the phenomenon three or four times for a couple of seconds only, he gradually reached the second cross-street of the main streets in question and here a thunder-like noise, lasting for a couple of seconds, and thereafter a ter-

rible crackling report, much louder than that of a cannon, first struck upon his ears. Immediately after the report, there ensued a crackling of a similar sort, and thereafter everything became and remained quiet. Since, during this observation itself, he neglected to look at his watch, Mr. v. Bäckmann later, upon my request, repeated his walk from the 'Krakau Suburb' to the 'New World,' or, if I may express it thus, he imitated his walk and this time measured its duration by means of a watch. He thereby reached the definite conclusion that the interval of time which passed between the luminous phenomenon of the aerolite and the consequent detonation had amounted to somewhat over 3 minutes." If one now calculates from the known velocity of sound, of 1023 Paris feet in 1 second, the distance corresponding to the interval of 210 seconds, one finds 9.4 geographic miles [1 geographic mile = 22,854 Paris feet, approximately]. However, precisely this distance of 9.4 miles results also if one computes the distance of the bursting point *B* [at a height of 5.6 miles as found earlier], from Warsaw, which is located at a horizontal distance of 7.5 miles from the projection of *B* on the Earth's surface. Accordingly, the explosion and the loss of the initial velocity can have occurred only perpendicularly above the territory of the fall. The assumption of a path proceeding in a fixed oblique direction up to the point of impact would bring the bursting point, which is 5½ miles high, so much closer to Warsaw that the interval of time until the detonation was heard would thereby result as too small by a whole minute, excluding even the contradiction mentioned before, between this preceding assumption and the observation at Danzig. It is natural to raise a question of possible changes in the speed of sound in a vertical direction and thru very rarefied air. However, it is to be remembered in this connection that a difference between the velocity of sounds proceeding from sources on high mountain tops and the velocity of sounds originating in sources on the plane of the observer, at or near sea level, has not been recognizable in experiments conducted up to now and that the most recent work of Regnault on this subject, published only this year, has indicated no change in the velocity of sound for different air densities, even for a fivefold change in pressure and density. Hence, there is not only no reason present for the supposition of an uncertain determination of the velocity of sound, but, instead, because the position of the bursting point was previously established accurately by a trigonometric method, one will be able to deduce from this observation a no-less-accurate confirmation of the constancy of the velocity of sound in the atmosphere up to a height of 5 miles.

Direct Observations of the Fall, Showing that the Stones Descended not with Planetary Velocity but with merely the Ordinary Velocity of Falling Bodies

The knowledge that meteor[itic] stones, by entering the lowest layers of the atmosphere, often lose completely their planetary velocity and finally fall simply like heavy bodies is nothing new; however, it would take us too far afield to collect here other examples where we have secured evidence of this relatively smaller velocity and energy of the dropping stones. In the present fall (as a consequence of the fact that the path could be calculated for this meteor), this fact is established partly by the demonstration of the transition of the oblique motion into a vertical one from the bursting point on and partly by direct observation of the fall itself. Dr. Neugebauer says on this subject in a letter received here: "One would expect that the stones must have fallen with terrible power onto the

Earth's surface. In reality, they nowhere broke thru the frozen layer of the ground, altho some penetrated deeply into it." If one calculates the time of descent and the final velocity of a falling body, starting from rest at a height of 5.6 miles, according to the law of gravitation, one finds for the duration of the fall 92 seconds and for the velocity reached at the Earth's surface 2780 Paris feet per second, where the former number is to be increased somewhat because of the resistance of the air and the latter for the same reason is to be diminished somewhat. Hence, one sees that the velocity amounts to only about 1/30 of the planetary velocity of, *e.g.*, the Earth. Furthermore, it is evident that such meteor[ite]s as are first stopped by bursting, at a height much less than 5.6 miles, can attain, in falling to the Earth, a velociy very much smaller still.

Observations of the Bursting, the Descent, and the Sound Phenomenon at Places Located Near the Point of Fall of the Stones

Altho observations of the bursting point, from the more distant places, agree well among themselves in several respects, it is more difficult to reconcile them with observations made at places lying close to the fall. Mr. Kowalcyzk reports the following on this subject: "The oral reports of the inhabitants of the village of Sokolow agree, according to Babczynski and Deike (Mr. Babczynski, a professor of mathematics, and Mr. Deike, an assistant at the Observatory, were commissioned with investigating the place of the fall on behalf of the Warsaw Academy), that about 20 seconds after the luminous phenomenon, a great clap of thunder, similar to a cannon-shot close at hand, could be heard; afterwards, single and separate, but less intense, reports followed. Over the entire extent of the area of fall, the inhabitants related that, before the detonation itself, a whizzing, similar to that of escaping steam, was audible." The height of the point where the bursting was seen at Sokolow Mr. Deike incidentally states as 50° and the azimuth as 15° W. of N., according to the statement of spectators there. (Refer to that position already reported before, for Sokolow, in a letter to Professor Karlinski.) In Sielc (Scheltz), on the other hand, the bursting was remarked almost in the zenith. For estimating the altitude of the point of burst, Mr. Deike availed himself of 2 sticks, intersecting at right angles. Moreover, in *The Austrian Journal for Meteorology*, **3**, p. 139, it is added that "at Sokolow, single reports, similar to platoon-fire, which lasted 6 to 10 seconds, followed the detonation. People sitting at home heard a whizzing, like escaping steam, between the flaring up and the thunder." "At Sielc, only 10 seconds elapsed between the bursting and the thunder, and one is thereby led to infer that the aerolite burst above the line which joins the village Rowy and Sielc." It may be stated further here that the falling stones distributed themselves over an elongated area, 1 mile wide and 7 miles long, which extends from the village Obryte (39° 2′.0 longitude from Ferro, 52° 42′.2 latitude) on, thru Ciolkow, Zambski, Gostkow, Rodziely, Rowy, and Sokolow, to Sielc (39° 3′.5 longitude, 52° 47′.0 latitude). "The shape of individual pieces is irregular, about like that of stones shattered by an explosion of powder; the edges are for the most part rounded off smoothly, and the outer surface is covered with a thin black or brown shell of iron oxide, under which small particles of iron are to be seen. In the interior of one of the meteorites collected was found a piece of pure iron, about a cubic inch in volume. It is to be noted finally that the sizes of the broken pieces vary greatly; thereby is revealed the surprising peculiarity that the stones found increase in size, the farther one follows along the course of the meteor; that is to say, altho, at