

1953

A New Copy Pencil: Restoration of Erasures and Consideration of its Chemical Properties

Heinrich Helldorfer

Follow this and additional works at: <https://scholarlycommons.law.northwestern.edu/jclc>

 Part of the [Criminal Law Commons](#), [Criminology Commons](#), and the [Criminology and Criminal Justice Commons](#)

Recommended Citation

Heinrich Helldorfer, A New Copy Pencil: Restoration of Erasures and Consideration of its Chemical Properties, 43 J. Crim. L. Criminology & Police Sci. 834 (1952-1953)

This Criminology is brought to you for free and open access by Northwestern University School of Law Scholarly Commons. It has been accepted for inclusion in Journal of Criminal Law and Criminology by an authorized editor of Northwestern University School of Law Scholarly Commons.

A NEW COPY PENCIL*

Restoration of Erasures and Consideration of its Chemical Properties

Heinrich Helldorfer

The author has been a member of the Nurnberg Police Department since 1945 and since 1947 Operations Officer of its Detective Department. Mr. Helldorfer has served as a Liaison Officer with the American Military Police and in 1951 received 90 days training in this country in American police methods. He has attended the Nurnberg Police School as well as the Bavarian School of Police Administration. For the last two years he has held the office of Secretary of the Bavarian Police Chiefs Association.—EDITOR.

In many types of investigations, the evidence includes documents on which pencil writing has been obliterated. Till now the basis for the successful restoration of obliterated pencil writings was the amount of graphite remaining in the pencil marks where the erasure has been made. One of the best methods for developing erased pencil writings was the use of infrared photography. But the infrared photography could not restore the writings if all of the graphite pencil markings have been removed in the erasing process. One of the last ways was to take advantage of the indentations made in the paper by the pencil, if they were present.

In any case it depends on the pencil, whether and by what mechanical or chemical means the writing can be removed and whether the obliterated writing can be made visible again.

A new pencil "Mars-Irremovo Pencil 7001," developed by a Nurnberg (Germany) pencil factory, is able to serve most of the hitherto existing problems. It can be said, that this kind of pencil constitutes the most important step forward—as far as criminal investigation is concerned—in the manufacture of a pencil. The quality of the pencil, which is so very important for criminal investigation, is made possible by the calcium chloride contained in the pencil leads.

Many experiments and tests have been made with this pencil by German Crime Laboratories and Institutes of Criminal Science. In the following, the findings of the test, especially the findings of the Criminal Science Institute of the University of Cologne on the "Mars-Irremovo Pencil 7001" may show its value for the criminal investigation.

In general, it can first be stated that the 7001 pencil (copying, soft, and, medium) is similar in writing characteristics, particularly in respect of hardness and wear, to known copying pencils, and that in particular because of these properties it is suitable for use in tropical climates.

*The author is willing to furnish document examiners and forensic chemists with sample pencils for further experimental work. Requests must be made on laboratory letterhead directly to the author.

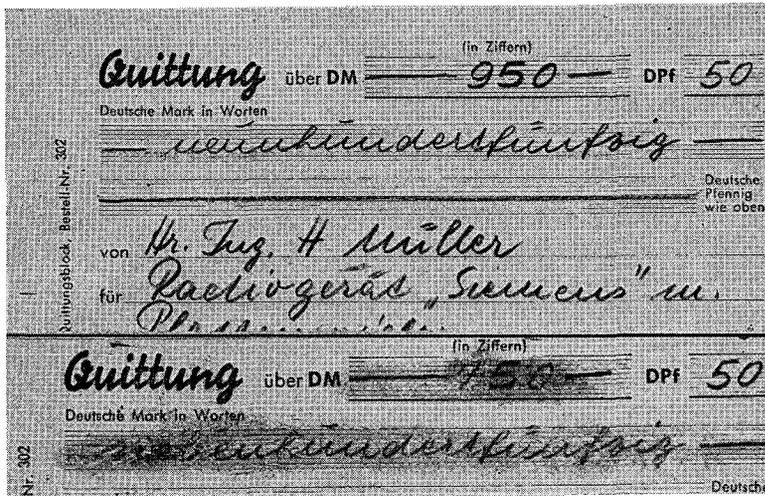


Figure 1

Top: An altered document before treatment. Bottom: Upper portion after original writing was restored.

Details of the examinations of writing done with the 7001 pencil are as follows.

BEHAVIOUR IN RESPECT OF ERASURE

Writing done with the 7001 pencil can, it is true, be partly removed with a hard rubber eraser, but complete erasing is possible only if the surface of the paper is severely damaged.

Writing deleted mechanically in this manner can however be made visible again by treatment such as has been found successful in the restoration of mechanically obliterated ink writing. Treatment with the following two solutions was found to be suitable. The portion of the paper containing the erasure (cut out) is first placed for a short time in a solution of 10% sodium nitrate (NaNO_2), which had been mixed with a 10% solution of silver nitrate until vigorous deposition of silver nitrate took place, and then acidified with 10% nitric acid. The document under examination is then thoroughly washed in 10% nitric acid, re-washed with distilled water containing a little nitric acid, and the resulting insoluble silver chloride is treated in a second solution, consisting of one part of a 35% solution of formalin and ten parts of 2% solution of caustic soda, until the silver chloride is completely reduced to black silver. The latent chloride tracing of the writing is thereby converted into a visible tracing. (Figure 1).

This chloride test, which was hitherto not possible with pencil writ-

ing, is possible because of the calcium chloride contained in the pencil leads.

DETERMINING AGE OF WRITING

There is no doubt that the same chloride test is also available for determining the age of writing made with the 7001 pencil. To what extent *absolute* determination of age is possible must be shown by further experiments, since the writing made by a pencil furnishes different conditions for the migration of the chlorine ions than those existing in the case of writing in ink. In the case of the former, this migration is solely dependent on atmospheric moisture. On the other hand, it can be stated at once that *relative* determination of age of writing is possible, particularly when there are long intervals between the writing of two texts (added matter). The migration of the chlorine ions into the breadth and depth of the substance of the paper also allows a chloride picture to be obtained in the case of writing made with the Mars-Irremovo pencil 7001, and this picture broadens with the course of time and appears as a mirror image on the back of the paper.

BEHAVIOUR IN RESPECT OF SOLVENTS

Removal of writing made with the 7001 pencil by solvents (alcohol, acetone, benzine, petrol, chloroform, methyl acetate, perhydrol, turpentine, etc.), applied to the writing by a wad of cotton wool, was not possible in any case. It is true that the colour of the writing with this pencil was changed to shades between blue and violet, but in all cases the legibility of the writing was fully retained.

Even when treated with formalin, although writing with the 7001 pencil then turned blue, it remained legible.

Special investigations were also carried out with Turkey red oil (50%) and necal, based on the following principles. It is a fact already established by Spring¹ that the colloidal bond of carbon with the cellulose of the paper cannot be destroyed by pure water, but that on the other hand pure colloidal carbon with a soap solution in water promotes its decomposition, effects the formation of an acid salt, and agglutinates with the latter to form an adsorption compound. This bond between the acid soap and the carbon is a bond such as occurs only between colloidal substances, and cancels the colloidal bond between the carbon and the cellulose of the paper.

For whereas the carbon black suspended in the water enters into a

1. Z.f.Chemie u. Industrie der Kolloide, Vol. IV, 1909, P. 161 et seq. See also Thomas, Colloid Chemistry 1. ed., 1934, p. 396.

permanent adsorption bond with the cellulose, and therefore, on filtration the carbon black is left entirely behind on the filter paper, and the water also can not wash anything off the filter when the latter is turned, a suspension of pine soot in soapy water passes completely through a filter paper.

Based on these considerations, writing made with the 7001 pencil was also treated on the hand with a 0.5% solution of Turkey red oil, and on the other hand with a 3% solution of neal in a 16% solution of Na_2SO_4 . In both cases the writing withstood this treatment. Since the colouring matter in this pencil does not participate in the colloidal bond.²

BEHAVIOUR IN RESPECT OF CHEMICALS

The chemicals in question were weak acids and alkali solutions, oxidising and reducing substances. Writing made with the 7001 pencil was subjected to the action of the following agents:

- a. "Tintentod" (Günther Wagner).
- b. Eau de Javelle.
- c. 2 *N* HCl.
- d. NH_4OH conc. (sal ammoniac).
- e. 2 *N* NaOH (caustic soda solution).
- f. KOH 4% (caustic potash solution).
- g. $\text{Ca}(\text{OCl})_2$ 20% (calcium hypochlorite).
- h. NaClO (sodium hypochlorite) & 12% act. Cl with *N*/10 HCl.
- i. *N*/10 SnCl_2 + *N*/10 HCl (stannous chloride in hydrochloric acid solution).
- k. *N*/10 $\text{Na}_2\text{S}_2\text{O}_3$ + *N*/10 NH_4OH (sodium hyposulfite in ammoniacal solution).

Treatment of writing with these substances had the following results:

Complete deletion of writing done with the 7001 pencil could be achieved only by means of "Tintentod," and substantial deletion by means of the acidified stannous chloride solution shown under *i*. In all other cases, although the writing was more or less weakened in intensity, it remained completely legible in a blue to violet colour. In the case of the complete deletion, it was possible to detect immediately the chemical treatment of the paper; particularly the treatment with the very corrosive reducing substances.

BEHAVIOUR IN RESPECT OF THE ACTION OF LIGHT AND WEATHER

Lines made by the 7001 pencil, of varying thickness down to very fine, scarcely visible lines, were exposed for four weeks to daylight, without

2. Regarding the concentration of the soap solution see in particular Fall, J.Phys.Chem., 31, 1927, 801; Lottermoser and Tesch, Kolloidchem. Beihefte 34, 1931, 339, and other.

it being possible to detect any bleaching of the same. The lines accordingly are not affected by daylight.

Similar lines were exposed continuously for four weeks on the weather side of a building to the action of rain and sunshine. Although the lines ran and were discoloured by the action of rain, their intensity did not diminish at all.

RENDERING VISIBLE THE LATENT CONTACT IMAGE

Investigations concerning the similarity to ink of the writing made with the 7001 pencil showed that this writing left a latent image on the paper which was in contact with this writing for about three weeks. It was possible to make this image visible by coating the paper which was not written on, in half-darkness, with a solution consisting of 5 gr. of silver nitrate, 1 gr. of citric acid, 0.5 gr. of tartaric acid, and 3 drops of nitric acid in 100 gr. of distilled water, drying, and then developing in daylight. The fact that this method can be used for making visible latent ink contact images even in the case of writing done with the 7001 pencil is a particularly important step forward in criminal investigation, and is likewise explained by the chloride content of the pencil lead.

GENERAL EVALUATION

With regard to the suitability of the Mars-Irremovo 7001 pencil for use for record purposes, principally from criminal points of view, the following can be said.

1. The hardness achieved, despite the very different chemical and physical composition of the pencil leads, provides resistance to mechanical erasure, which is at least equal to that of the best ordinary pencils. In particular, complete deletion of the writing is possible only by considerably damaging the surface of the paper.

2. Writing done with the 7001 pencil is completely waterproof and weather-resistant and is not changed in any way by the action of light. The running of the writing which occurs under the action of rain does not at all affect legibility.

3. In respect of solvents, oxidising agents, and reducing agents, writing made with the 7001 pencil shows the same resistance as good permanent record inks, that is to say they can be made invisible only with the strongest reducing agents. In the case of complete removal, the chemical treatment on the paper can be seen at once.

4. Through the addition of chloride to the pencil leads the following effects have been achieved:

- a. Writing removed by mechanical erasure can be restored to visibility by the so-called chloride test (Metzger, Rall, and Hess method). (Chloride image).
- b. The latent contact image produced by the 7001 after only 2 to 3 weeks can also be made visible with the aid of a determined silver nitrate solution with the addition of other reagents mentioned above.
- c. The possibility of a relative determination of age exists, i.e. subsequent additions made to a document written with the Mars-Irremovo 7001 pencil can be recognised as such.

The findings listed under a to c make it possible for the first time in laboratory investigation of such documents to have the same facilities as hitherto have existed only for documents written in ink. For this reason the 7001 pencil can also be acknowledged as a substitute for ink writing for record purposes and offers securities against falsifications.